XXIII. *On the Satellites of the Planet Saturn, and the Rotation of its Ring on an Axis.* *By* William Herſchel, *LL.D.* *F. R.* S.

Read June 17, 1790.

IN my laſt Paper on the Planet Saturn, the principal object of which was to give an immediate account of the moſt intereſting phænomena that had occurred till the beginning of November, many things were left unnoticed for want of time to treat of them with ſufficient accuracy; but having now before me the whole ſeries of obſervations from the 18th of July till the 25th of December, 1789, I can enter into a proper examination, aſſiſted by ſuch neceſſary calculations as then could not conveniently be made.

One of the principal motives which have induced me to haſten this inquiry, is the frequent appearance of protuberant and lucid points on the arms of the ring of Saturn. I have mentioned before that ſuch phænomena had been reſolved by the ſituation of ſatellites that put on theſe appearances; but as my obſervations were continued near two months afterwards, and as I had from them corrected the epochæ of the old ſatellites, and improved the tables of the new ones, I found that, beſides many of theſe bright points which were completely accounted for by the calculated places of the ſatellites, there were alſo many more mentioned in my journal that would not accord with the ſituation of any of them.

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The queſtion then preſented itſelf very naturally, what to make of theſe protuberant points? To admit two or three more ſatellites by way of ſolving ſuch phænomena appeared to me too hazardous an hypotheſis; eſpecially as theſe lucid points, though ſome of them had a motion, did not ſeem willing to conform to the criterion I had before uſed of coming off the ring, and ſhewing themſelves as ſatellites. And yet a ſuſpicion of at leaſt one more ſatellite would often return; it was even conſiderably ſtrengthened when I diſcovered, by means of re-calculating with great preciſion the whole ſeries of obſervations, that in the beginning of the ſeaſon there had been ſome few miſtakes in the names of the ſatellites, when the obſervations of them were entered in the journal. In ſetting them right, which threw a great light upon the revolution of the 6th, and more eſpecially upon that of the 7th, I found alſo, that ſome of the obſervations which were entered by the name of the 7th ſatellite could not belong to that, nor to any other known one. It remained therefore to be examined whether there might not be ſufficient ground to ſuſpect the exiſtence of an eighth ſatellite.

In this ſituation of things, I thought it moſt adviſable to draw out the whole ſeries of obſervations in a paper, beginning at the 5th ſatellite, and thus gradually through the 4th, 3d, 2d, 1ſt, 6th, and 7th, to approach towards the center of Saturn; that it might appear at laſt what obſervations were left unaccounted for. By this means alſo it will be ſeen clearly with how ſcrupulous an attention the identity of every ſatellite has been aſcertained; and with a view to give the ſtrongeſt ſatisfaction in this reſpect, at leaſt one obſervation of each has been calculated for each night; and the place thus computed is put down in the notes, that it may be compared with the obſerved one.

To facilitate this compariſon, I have delineated a ſcheme *, wherein the orbits of the ſatellites are drawn in their due proportion. A few words will explain the conſtruction and uſe of this figure, which, notwithſtanding its ſimplicity, is yet amply ſufficient to aſcertain the accuracy of every obſervation.

In each of the orbits, by way of marking them, is placed the ſatellite to which it belongs, as it appeared to be ſituated the 18th of October, 1789. The graduated circle is of uſe to find, by means of the tables, the apparent place of a ſatellite for any given time; or, the apparent ſituation of the ſame ſatellite being given, its real Saturnicentric place may be deduced from it. In the center of the ſcheme is the planet Saturn, and its ring, expreſſed by a line which repreſents the direction of its anſæ; or the ring itſelf, as it appeared in my teleſcopes during the months of July, Auguſt, September, October, and November, 1789. The five lines which are carried on parallel to each other ſerve to convey the meaſure of the planet, and its ring, to the orbits of the ſatellites, as will be ſeen in ſeveral inſtances that occur hereafter.

The graduated circle is divided into degrees, and begins to count from that part of every ſatellite's orbit beyond the planet, which is intercepted by a plane paſſing from the eye of the obſerver, at rectangles to the ring, through the center of Saturn. Hence it follows, that the point of zero, or 360 degrees, is the ſame with the geocentric place of the planet in thoſe four parts of the orbit of the ſatellite where the eye is in the plane of the ring, and where it appears the moſt open; and that, in other places, it may be had by ſolving one ſpherical triangle. This is to be underſtood as relating only to

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* See Tab. XIX. fig. 1.

the inner ſatellites; the 5th, or outermoſt, requiring a different reduction, on account of its deviation from the plane of the ring. Moreover, I am inclined to believe, that the ſureſt way of obſerving the 5th, is to truſt only to meaſures, taken with micrometers which give the diſtance and angle of poſition, except in ſuch caſes when the eye is nearly in the plane of this ſatellite's orbit, where the different reductions may be neglected, without bringing on any conſiderable inaccuracies. The order of the numbers by which 90 comes to the left, and 270 to the right, is taken from the motion of the ſatellites, as they appear to revolve in their orbits, when ſeen in teleſcopes of my conſtruction; and which is alſo the real direction of their motion according to the order of the ſigns. But the points 360 and 180 muſt occaſionally be changed in their denomination of north or ſouth, according to the real ſituation of the plane of each ſatellite's orbit. At preſent, for inſtance, when the ſatellites are at 360, that part of their orbits in which we find them lies to the ſouth of the center of the planet; but about the end of Auguſt, 1789, and afterwards, the orbits of the ſix inner ſatellites were differently ſituated; ſo that the ſame points then were turned towards the north. I need not remark, that the ſituation of theſe points was changed again when the earth paſſed through the plane of the ring, and that it will change, in the 5th ſatellite likewiſe, when we come to be in the plane of its orbit.

The calculations of the places of all the ſatellites have been made according to tables which are given at the end of this Paper. Their form being very ſimple, I thought it not amiſs to communicate them, for the uſe of thoſe who may wiſh to enter into a more particular examination of the following obſervations; or to follow the ſatellites in their orbits at any

future

future time. It will be proper to mention, that I have deduced the epochæ of all the ſeven ſatellites from my own obſervations, and they will be found to differ conſiderably from thoſe which are given by M. DE LA LANDE, in the *Connoiſſance des Temps* for 1791. But I have not attempted to extend them farther than a few years backwards or forwards, as I am not in poſſeſſion of any obſervations that could authorize me to undertake ſuch a work. On the contrary, I am well convinced, that no tables will give us the ſituation of the ſatellites accurately, till we have at leaſt eſtabliſhed the dimenſions of their elliptical orbits, and the motion as well as the ſituation of their aphelia. The epochæ for 1789, therefore, muſt be looked upon not as *mean* ones, but ſuch as reſpect the orbits of theſe ſatellites in their ſituation during the time of the following obſervations; and the two preceding, and two following years, muſt be already a little affected with thoſe errors which are the neceſſary conſequence of our not knowing the required elements. I flatter myſelf, however, that the obſervations, which are delivered in this Paper, will ſerve as a beginning to a proper foundation for inveſtigating them. The many conjunctions between the ſatellites, for inſtance, will undoubtedly throw ſome light on the ſituation and excentricity of their orbits; as it will be found, that the calculated places of theſe conjunctions require elliptical motions to bring the ſatellites to ſuch appearances, which, in circular orbits, could not ſo accurately have taken place. Nor can we aſcribe the diſagreements to the fault of the obſervations, ſince a very few minutes will ſuffice to determine the time of a conjunction, which never laſts long. For this reaſon alſo, I have carefully avoided deducing my epochæ from conjunctions, even with the 6th ſatellite, which moves ſo rapidly that, at firſt ſight, we might think thoſe ſituations favourable.

The mean motion of the five old ſatellites, as being ſufficiently accurate for my preſent purpoſe, I have taken from the above-mentioned tables of M. DE LA LANDE; and thoſe of the 6th and 7th, of courſe, are the reſult of my own obſervations.

The geocentric place of Saturn, whoſe complement is to be added, in order to reduce the Saturnicentric ſituation of the ſatellites to the apparent one, I have taken from the nautical almanac to the neareſt minute; and, as I have always confined myſelf to a literal tranſcription of the obſervations from the original journal, all the memorandums which are neceſſary either to explain them, or to correct miſtakes in the names of the ſatellites, are thrown into notes, that there may be no interruption in the ſucceſſion of the obſervations.

Obſervations on the fifth ſatellite of Saturn.

1789, July 18. 20 h. 20′ (A). The ſuppoſed fifth ſatellite (B) 6° or 7° ſp. (C) the ring (D).

July

(A) The time of my obſervations being ſidereal, it is neceſſary to mention, that this relates only to the hours, minutes, and ſeconds, the day itſelf being that which is generally uſed by aſtronomers, beginning at noon, and ending the noon following. By this means there can never be a miſtake which ſidereal hour I mean to point out, as no two ſuch hours can occur in the ſame aſtronomical night.

It will alſo be neceſſary to remark, that all the times are thoſe ſhewn by the clock; which, by equal altitudes, has been found to loſe very equally at the rate of 0″,4 *per* day; and to be 8′ 51″,5 too faſt at midnight the 18th of July, 1789, which is the time on which my obſervations on Saturn commenced.

(B) The ſatellite itſelf not being known, it is here called the ſuppoſed fifth.

(C) By ſix or ſeven degrees ſouth preceding the line of the ring, is meant, that

July 23. 19 29. The 5th ſp. at a great diſtance (E).

July 28. 22 37. By a figure in the journal, at a great diſtance np. (F).

Aug. 18. 21 11. The ſuppoſed 5th at a great diſtance 25° np. R. (G).

Aug. 28. 1 28. A line drawn through a large ſtar north of Saturn, and paſſing between one pretty conſiderable ſtar nf. and another ſf. Saturn, leaves the ſuppoſed 5th ſatellite a little on the following ſide. By two figures in the journal, the 5th is at a great diſtance nf. ♄. (H).

Aug. 29. 23 29. The ſuppoſed 5th is a very little preceding a line drawn from the large ſtar of laſt night, through a very ſmall ſtar; and a good deal following a line drawn from the

that the ſatellite in the firſt place was at the preceding ſide of the planet; that is, in the ſemicircle from 180 to 360, which paſſes through 270 degrees. And in the next, that the ſituation of its orbit was ſuch as to bring the ſatellite, at its proper diſtance, into a line drawn from the center of Saturn, making an angle of 6 or 7 degrees with the line of the ring, and declining towards the ſouth.

(D) The calculated place for 20 h. 20′, ſhewn by the clock, corrected by —8′ 51″,5, and reduced to 12 h. 22′ 16″ mean time, is 245°,5 which, as no diſtance is mentioned, leaves it doubtful whether the obſervation was that of the 5th ſatellite, or of a fixed ſtar.

(E) By calculation the ſituation is 268°,1; which agrees well enough for 11 h. 11′ 47″ mean time.

(F) 13 h. 59′ 38″ mean time gives 291°,5, which agrees with the diſtance and direction; but as the ſatellite was ſp. the obſervation, which ſays np. muſt belong to ſome ſmall fixed ſtar.

(G) The calculation for 11 h. 11′ 27″ gives 27°,4 or at a good diſtance ſf; therefore this was not the ſatellite, but a ſtar.

(H) It appears from the calculation for 14 h. 48′ 29″ which gives 74°,2, and alſo from the following obſervations, that this was the real 5th ſatellite; and that, having once obtained its place, I kept it in view all the reſt of the ſeaſon.

firſt pretty conſiderable ſtar of laſt night, through the ſame very ſmall ſtar (I).

Aug. 31. 21 3. The 5th I take to be nf. ♄ at a good diſtance (K).

Sept. 8. 22 37. The 5th about 15° nf. R. and, by a figure, at a great diſtance (L).

Sept. 11. 20 11. The ſuppoſed 5th ſatellite and two ſmall ſtars ſf. a ſtar x, which is ſf. ♄, form an exact line.

22 32. The ſuppoſed 5th, and the two S ſt. ſf. x, form no longer a line; ſo that is the real fifth ſatellite.

Sept. 11. 23 52. The 5th ſatellite keeps advancing; its ſituation is 20 or 22° nf. the line of the R. and, by a figure, it is at a conſiderable diſtance (M).

Sept. 13. 22 17. The 5th ſat. of the 11th of Sept. is advanced, and is now north preceding a conſiderable large ſtar, which was that night ſp. ♄. By a figure it is nf. ♄, at a conſiderable diſtance (N).

Sept 14. 20 33. The 5th a little nearer than laſt night (O).

22 30. The 5th ſat. of Sept. 11. obſerved at 20 h. 11′, has left the place where it was at that time.

Sept. 16. 19 39. The 5th is drawing nearer towards its conjunction.

22 18. Much the ſame as before.

23 59. About 33° north following the direction of the R. (P).

1 3. The 5th nearly as before.

	h.	′	″	°		h.	′	″	°
(I)	12	45	53.	78,4.	(K)	10	12	26.	87,2.
(L)	11	14	47.	124,2.	(M)	12	17	48.	138,3.
(N)	10	35	13.	147,2.	(O)	8	47	34.	151,5.
(P)	12	5	9.	161,3.					

Sept. 17. 19 48. The 5th ſat. of ♄ 30° nf. R. and at the diſtance of about 3 dia. of R. (Q).

Sept. 18. 21 15. About 2 dia. of R. and near 40° north following (R).

Sept. 20. 23 24. The 5th ſat. is within a degree of its conjunction. It is north of ♄ , and its motion is retrograde.

23 54. A perpendicular from the 5th ſat. to the ring of Saturn, falls towards the following ſide ſhort of the center by $\frac{1}{6}$ dia. of ♄ .

0 19. Diſtance of the 5th ſatellite from the parallel of the R. of ♄ , 3 rev. 36,7 parts = 1′ 0″,966 central meaſure.

1 25. The 5th very nearly central.

1 28. With a power of 240, perfectly central. With 300, perfectly central (S).

Sept. 21. 21 15. The 5th ſat. is perpendicular to a place half a projection of the ring preceding the edge of it (T).

Sept. 23. 22 51. At a conſiderable diſtance np. ♄ (V).

Sept. 24. 19 56. At a good diſtance np. ♄ (W).

Sept. 25. 19 34. The 5th purſues its track (X).

h. ′ ″ ° h. ′ ″ °
(Q) 7 50 55. 165,1. (R) 9 13 45. 170,0.

(S) 13 18 13. 180,0, or directly at rectangles to the ring, to the north. I have uſed this obſervation for ſettling the epocha of this ſatellite, in which I have made no other allowance than that of the geocentric place of Saturn, as I knew this would anſwer all my purpoſes. But when we would obtain the mean motion of this ſatellite in comparing its preſent place with other ſituations at a great diſtance of time, proper reductions of the geocentric place of ♄ to the orbit of this ſatellite ſhould be made. This may, however, be done much better when the real ſituation of its orbit is properly aſcertained.

h. ′ ″ ° h. ′ ″ °
(T) 9 1 59. 183,8. (V) 10 29 52. 193°,3.
(W) 7 31 25. 197,4. (X) 7 5 33. 201,9.

Oct. 12. 21 18. The ſuppoſed 5th forms nearly an iſoſceles triangle with two preceding ſtars, the ſouthern one of which is double, conſiſting of a very conſiderable ſtar and a ſmall one. By a figure, at a conſiderable diſtance, np. ♄ (Y).

Oct. 15. 21 1. The large ſtar of the double ſtar in the figure of the 12th of Oct. is gone from its place, and the ſuppoſed 5th of that night is left (Z).

21 8. The real 5th is ſo bright this evening, and was ſo the 12th of Oct. that I miſtook it on that account for a conſiderable ſtar; it was then nf. ♄. By three figures to-night it is at a great diſtance np. ♄. I ſaw it move to-night; for at 21 h. 1′ it made an angle of 50° on the following ſide with three ſtars in a line, ſp. ♄. At 1 h. 9′, that angle was leſs than 40°; and at 1 h. 41′, it was no more than about 35°.

Oct. 16. 20 16. The 5th now precedes a line drawn through the three ſtars which it followed laſt night at 21 h. 1′. By five figures, at a great diſtance ſp. ♄ (A).

Oct. 18. 20 18. At a great diſtance ſp.

21 51. At 7 or 8′ diſtance ſp. The ſame by two figures (B).

Oct. 20. 20 50. By three figures, at a great diſtance ſp. (C).

Oct. 28. 21 1. The 5th about 3½ dia. of ♄ diſtant, and 45° ſp. (D).

Oct. 29. 21 49. The 5th ſat. of ♄ is approaching towards its oppoſition (E).

(Y) 7 h. 42′ 32″. 280°,3. The diſtance and ſituation agree well enough, but not the angle, which, by what will appear hereafter from the ſituation of the nodes of this ſatellite, ſhould be ſp.

	h.	′	″	°		h.	′	″	°
(Z)	7	13	49.	294,0.	(A)	6	25	0.	298,4.
(B)	7	51	54.	307,9.	(C)	6	43	13.	316,8.
(D)	6	22	47.	353,4.	(E)	7	6	44.	358,1.

Oct. 30. 20 53. The 5th ſat. is paſt the oppoſition a little more than yeſterday it wanted of it (F).

Oct. 31. 21 13. The 5th about 3½ diameters of Saturn ſf. (G).

21 43. It is very faint; fainter than the firſt; not much brighter than the ſixth (H).

Nov. 2. 23 57. By a figure, the 5th ſat. at ſome diſtance ſf. (I).

Nov. 3. 22 1. At a good diſtance ſf. R. (K).

22 13. The 5th a little following a line drawn through two fixed ſtars and between them. It is ſouth of the ring.

Nov. 4. 22 17. The 5th at a great diſtance following, and a very little ſouth; it precedes the line of the two ſtars which it followed laſt night (L).

Nov. 7. 22 9. The 5th at a great diſtance following, and a little north (M).

Nov. 8. 20 46. At a great diſtance following (N).

Nov. 10. 23 30. As the calculation gives it (O).

(F) 6 h. 6′ 57″. 2°,5. (G) 6 h. 22′ 59″. 7°,1.

(H) From the conſiderable change in the light of this ſatellite, we may ſurmiſe, that it has a revolution upon its axis; the ſituation (ſee note Z and G), which affects the apparent brightneſs, ſhould however be taken into the account.

(I) 8 h. 58′ 41″. 16°,8. (K) 6 h. 59′ 4″. 21°,0.

(L) 7 h. 11′ 6″. 25°,2. A few days ago I perceived, that in the former part of theſe obſervations I had omitted a pretty eſſential circumſtance, which is an attention to the nodes of the 5th ſat. with the ring of Saturn.

(M) 6 h. 51′ 21″. 39°,2. It appears from this and the foregoing obſervation, that the aſcending node of the 5th ſatellite, with regard to the ring of Saturn, apparently lies between the 25th and 39th degrees, which, reduced to a Saturnicentric poſition, is about the 19th degree from the point Aries reckoned upon the ring.

(N) 5 h. 24′ 39″. 43°,5. (O) 8 h. 0′ 21″. 53°,0.

Nov. 13. 22 33. On the following ſide (P).

Nov. 15. 22 33. By a figure, nf. Saturn at a great diſtance (Q).

Nov. 19. 22 15. Diſt. of the 5th. ſat. 1ſt meaſure 8 54,94
but too ſmall.
22 28. — — 2d — 8 58,28
22 43. — — 3d — 8 58,23
22 54. — — 4th — 8 58,85
Mean of the three laſt meaſures 8′ 58″,45.

This, when the exact inclination of the orbit is aſcertained, muſt be brought to the greateſt elongation, and alſo reduced to the mean diſtance of the planet from the ſun.

Dec. 2. 0 56. The 5th ſat. is in its calculated place (R).

Dec. 5. 0 10. As the calculation gives it (S).

Dec. 16. 23 59. At a great diſtance preceding (T).

Obſervations on the fourth ſatellite of Saturn.

July 18. 19 50. The 4th ſatellite is about 6 or 7° np. R. (A).

July 23. 19 29. About $3\frac{1}{2}$ dia. of ♄ following the body (B.

	h.	′	″	°		h.	′	″	°
(P)	6	51	44.	66,5.	(Q)	6	43	53.	75,6.
(R)	7	59	46.	152,8.	(S)	7	2	7,	166,2.
(T)	6	7	58.	215,4.	(A)	11	52	21.	284,0.
(B)	11	11	47.	36,4.					

Following or preceding the *body*, denotes that we are to reckon from the neareſt part of the circumference, and not from the center; but it is alſo to be obſerved, that eſtimations in diameters, when they exceed one, or one and an half, are not intended as meaſures, but merely to point out the ſituation in a very coarſe way; ſo that we are to look upon the calculation as not diſagreeing with this eſtimation, though we ſhould find the ſatellite conſiderably farther from the body.

July 27. 20 27. 4 or 5 dia. following (C).

July 28. 19 40. Near 4 dia. following (D).

Aug. 18. 21 11. Many dia. preceding (E).

Aug. 28. 0 14. About 4½ dia. of ♄ following the body (F).

Aug. 29. 22 18. 3 dia. of ♄ following the body (G).

Aug. 31. 20 48. About 2¼ dia. of ♄ p. the body; a few ſeconds farther off than the 2d ſatellite, and a little ſouth of it (H).

Sept. 8. 22 30. About 2½ dia. of ♄ following the body (I).

Sept. 10. 19 42. Following Saturn (K).

Sept. 11. 20 26. Following ♄, too far to eſtimate by the diameter (L).

Sept. 13. 22 17. By a figure, at a diſtance following (M).

Sept. 14. 20 33. About 1¾ dia. of the ring following (N).

0 42. 1¼ dia. of R. f. the edge.

1 24. 1 dia. of R. f. the ring; exactly in the line.

Sept. 16. 19 37. Not quite 1 dia. of the ring preceding (O).

22 15. 1½ dia. of R. p. the edge, and a little ſouth.

23 59. Near 1½ dia. of R. preceding the edge of the ring.

Sept. 17. 19 48. About 3 dia. of the ring p. the projection (P).

Sept. 18. 21 15. Almoſt at its greateſt diſtance p. (Q).

	h.	′	″	°		h.	′		°
(C)	11	53	55.	127,5.	(D)	11	3	7.	149,3.
(E)	11	11	27.	264,7.	(F)	13	34	42.	133,4.
(G)	11	35	5.	154,2.	(H)	9	57	29.	198,0.
(I)	11	7	48.	20,3.	(K)	8	12	24.	62,8.
(L)	8	52	22.	86,1.	(M)	10	35	13.	133,0.
(N)	8	47	34.	154,0,	(O)	7	43	52.	198,3.
(P)	7	50	55.	221,[illegible].	(Q)	9	13	45.	245,0.

Sept. 20. 23 24. At a great diſtance p, and a little n. (R).

0 40. I can ſee the 4th ſatellite of Saturn without an eye-glaſs in the 20-feet ſpeculum by drawing back the eye about three or four feet.

21. Sept. 21 15. At a good diſtance preceding, and a little north (S).

Sept. 23. 22 33. The 4th ſatellite emerged a few ſeconds ago. It is now in the line of a tangent to that part of Saturn where the projection of the ring comes from the body (T).

22 51. ⅓ of the projection (V) following the body of ♄; and about 2 of its own diameters north of the ring; or not quite half way northwards between the center of ♄ and the northern limb.

Sept. 24. 19 56. About 2 of its own dia. nearer the ring than the 3d ſat. and a little more north.

20 48. The 4th advances to its conjunction with the 3d.

22 47. The 4th is paſt by the 3d. By a figure, it is leſs than one of its diameters paſt the 3d ſatellite, and is more north than the 3d (W).

Sept. 19 34. It purſues its track (X).

Oct. 12. 20 37. At a great diſtance following (Y).

Oct. 15. 20 54. Many diameters of Saturn f. (Z).

23 20. The 4th ſat. at a conſiderable diſt. f.

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	h	′	″	°		h.	′	″	°
(R)	11	14	33.	292,2	(S)	9	1	59.	312,8.
(T)	10	11	55.	359,2.					

(V) The diſtance from the body of Saturn to the end of the projecting part of the ring, I call the projection, and have made uſe of it as a meaſure for eſtimating.

	h.	′	″	°		h.	′	″	°
(W)	10	21	57.	22,0.	(X)	7	5	33.	41,6.
(Y)	7	1	39.	66,5.	(Z)	7	6	50.	134,4.

Oct. 16. 20 16. 2½ dia. of ♄ following the body.

21 59. The colour of the 4th ſatellite is red, or inclining to red; it approaches towards a conjunction with the 3d.

0 9. The 4th is very nearly in conjunction with the 3d; it is about ¼ of its own dia. nearer to Saturn than the 3d, and near one dia. of the 3d ſatellite more ſouth than the 3d (A).

Oct. 18. 20 18. 2½ dia. of ♄ p. the body.

21 51. About 2½ dia. of ♄ preceding (B).

Oct. 20. 20 50. At a great diſtance preceding (C).

Oct. 28. 21 1. At a great diſtance following (D).

Oct. 29. 21 49. At a good diſtance ſf (E).

Oct. 30. 20 53. At a great diſtance following (F).

Oct. 31. 21 13. At a conſiderable diſtance following (G).

Nov. 2. 21 6. The 4th ſat. is inviſible.

21 51. I cannot ſee the 4th ſatellite (H).

22 53. The 4th ſat. is not viſible; I looked for the ſhadow of it upon ♄, but could not perceive it. The weather a little hazy.

23 21. Upon the dark equatorial belt of ♄, on the f. ſide, near the edge of the diſk, ſeems to be a ſmall black ſpot which is darker than the reſt of the belt.

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	h.	′	″	°		h.	′	″	°
(A)	10	17	22.	160,1.	(B)	7	51	54.	203,0.
(C)	6	43	13.	247,2.	(D)	6	22	47.	67,9.
(E)	7	6	44.	91,2.	(F)	6	6	57.	112,8.
(G)	6	22	59.	135,7.					

(H) The tables I uſed at the time of this obſervation being different from my preſent ones, I expected the 4th ſatellite to be paſt its conjunction, and conſequently viſible again.

23 29. A protuberance on the ſp. part of ♄; I ſuppoſe it to be the 4th ſatellite emerging.

23 31. The black ſpot upon the equatorial belt ſeems to be a little advanced towards the preceding ſide.

23 38. With 300 the ſatellite is very nearly detached; the black ſpot keeps advancing; it is a very little north of the equatorial belt, but part of it is upon the belt.

23 43. The black ſpot is a little more than $\frac{1}{8}$ of the dia. of ♄ advanced from the f. ſide towards the center.

23 46. The ſatellite ſeems to be detached.

23 47. With 300, it is detached; and the black ſpot keeps advancing.

23 57. The black ſpot is advanced ſo as to be $\frac{1}{3}$ of its way towards the center; the 4th ſatellite is near $\frac{1}{2}$ its own dia. clear of the edge.

0 13. The black ſpot a little more than half way towards the center; it is much darker than the belt.

0 34. The black ſpot is not arrived to the center yet.

0 53. The black ſpot is not come to the center, but does not want much of it.

0 57. It is more upon the belt than it was before; that is, more ſouth.

1 6. The black ſpot is not yet come to the center.

1 10. It is drawn towards the ſouth, ſo as to be nearly in the middle of the equatorial belt.

1 11. It is not far from a central poſition.

1 15. It is not come to the center yet.

1 18. The black ſpot is very near central.

1 21. Very near central.

1 25. Begins to be in the center.

1 30. It is in the center (I).

Nov. 3. 22 1. The 4th ſat. about 3 dia. p. the body (K).

Nov. 4. 22 17. At a conſiderable diſtance preceding (L).

Nov. 7. 22 9. At a good diſtance preceding (M).

Nov. 8. 20 46. At a good diſtance p. (N).

Nov. 10. 21 3. The 4th ſatellite not yet viſible.

21 32. Not yet viſible.

22 26. Not yet viſible.

23 24. About ½ dia. of ♄ nf. (O).

Nov. 13. 22 33. On the following ſide (P).

Nov. 15. 22 33. Following ♄ at a good diſtance (Q).

Nov. 26. 0 28. The 4th ſatellite is emerged ſome time paſt.

0 30. It is nearly in conjunction with the 6th. By a figure, it is half the diameter of the 6th nearer to Saturn than the ſixth, and north of it (R).

Nov. 30.	23 36.	Diſt. of the 4th ſatellite	3′ 12″.379.
	23 42.	2d meaſure —	3 10 .972.
	23 52.	3d — —	3 10 .494.
	23 59.	4th — —	3 10 .579.

Mean of the four meaſures 3′ 11″.106 (S).

(I) 10 h. 31′ 25″,5. 184°,8. An extract of theſe obſervations being printed in my laſt Paper, I am to remark, that here the time is uncorrected; but the correction for this evening being — 8′ 8″,7, it will be ſeen, that in the former Paper — 8′ has been applied to all the times, and — 8′ 9″ to the time of the exact conjunction.

	h.	′	″	°		h.	′	″	°
(K)	6	59	4.	204,1.	(L)	7	11	6.	226,9.
(M)	6	51	21.	294,4.	(N)	5	24	39.	315,6.
(O)	7	54	22.	3,1.	(P)	6	51	44.	69,9.
(Q)	6	43	53.	115,0.	(R)	7	57	23.	4,4.

(S) The middle of the time to which we may ſuppoſe the meaſures to anſwer

Dec. 2. 0 56. In its calculated place (T).

Dec. 5. 0 10. As the calculation gives it (V).

Dec. 16. 23 59. At a great diſtance following (W).

0 43. The 4th ſatellite, with a power of about 500, ſhews a pretty conſiderable, viſible diſk (X).

Obſervations on the third ſatellite of Saturn.

July 18. 19 50. The 3d ſatellite about 1 or 2° ſf. R. By a figure, at a conſiderable diſtance (A).

July 23. 19 29. Near 2 dia. of ♄ following (B).

July 27. 20 27. About 2½ dia. of ♄ following (C).

July 28. 19 40. The 3d ſat. ½ dia. following ♄; it is much larger than the 2d, and a little more north.

22 34. ⅓ part of a dia. following (D).

Aug. 18. 21 11. 1½ dia. of ♄ following the ring (E).

Aug. 28. 0 14. Full 2 dia. f. ♄ (F).

is 23 h. 48′, or 6 h. 59′ 48″ mean time. And by computation the apparent place of the ſatellite at that time was 93°,778, which is 3°,778 or 3° 46′ 41″,52 paſt the greateſt elongation; therefore its diſtance, if it had been meaſured at the greateſt elongation, would have been 3′ 11″,522. This quantity brought to the mean diſtance of Saturn from the ſun, amounts to 3′ 8″,918.

	h.	′	″	°		h.	′	″	°
(T)	7	59	46.	139,8.	(V)	7	2	7.	206,6.
(W)	6	7	58.	93,6.					

(X) And from its ruddy colour (ſee Oct. 16.) we may ſurmiſe it to have a conſiderable atmoſphere. This ſatellite, therefore, ſeems to approach more to to the condition of a planet than any of the fourteen known ſatellites.

	h.	′	″	°		h.	′	″	°
(A)	11	52	41.	85,5.	(B)	11	11	47.	121,9.
(C)	11	53	55.	83,1.	(D)	13	56	39.	169,6.
(E)	11	11	27.	35,0.	(F)	13	34	42.	120,6.

Aug. 29. 22 21. A ſatellite on the edge of the preceding arm (G).

23 1. The ſat. a very little ſeparated from it. I ſuppoſe it to be the 3d, on account of its ſize and brightneſs.

23 41. The ſatellite is now fully detached, ſo as to be near ⅓ of the projection preceding the end of it.

Aug. 31. 20 56. The preceding arm, about the middle, ſeems to be charged with a ſatellite; power 157 (H).

21 3. With 300, the ſame as before.

Sept. 8. 22 30. The 3d ſat. about 2½ or 3 dia. of Saturn p. the body (I).

Sept. 10. 19 42. The 3d following Saturn (K).

Sept. 11. 20 26. 1½ dia. of ♄ f. the body of ♄.

22 36. 1 dia. of ♄ f. the body.

0 16. The 3d a little leſs than the projection from the f. edge.

0 34. ¾ of the projection following the ring.

1 57. A little leſs than ½ the projection f. the ring (L).

Sept. 13. 22 2. The 3d, 1¼ dia. of R. preceding the edge of R. (M).

Sept. 14. 20 27. The 3d ſat. ½ the projection f. R. (N).

21 55. 1⅓ of the projection f. and a very little north.

0 42. 2 projections following.

1 24. Near two projections following.

Sept. 16. 22 18. (O).

	h.	′	″	°		h.	′	″	°
(G)	11	38	5.	193,9.	(H)	10	5	27.	348,3.
(I)	11	7	48.	269,9.	(K)	8	12	24.	59,7.
(L)	14	22	27.	159,9.	(M)	10	20	15.	306,1.
(N)	8	41	35.	20,4.					
(O)	10	24	26.	185,6.					

By this it appears that the 3d ſatellite was inviſible; but obſervations being made on a ſatellite, by miſtake ſuppoſed to be the third, they will be found among thoſe of the 6th, to which they belong.

Sept. 17. 19 48. The 3d ſat. 1¾ dia. of the ring preceding the projection (P).

Sept. 18. 21 15. ⅓ of the projection, or 1½ dia. of the ſatellite preceding the edge of the ring.

21 45. ¼ of the projection preceding R.

21 53. The 3d almoſt touches the R.

21 59. Quite cloſe to the ring, and a little north.

22. 7. Not quite ſo near but that I can ſtill ſee a ſmall diviſion.

22 20. With 157, I can no longer ſee a diviſion between the 3d ſatellite and the R.

22 22. With 300, the ſat. is completely joined to the R. but ſo as to make it appear a little longer, and a very little knotty towards the north (Q).

Sept. 20. 23 27. The 3d ſat. 1½ projection f. R. It is within leſs than the diameter of the 2d ſatellite preceding the 2d, and a little more ſouth (R).

23 51. The 3d ſat. is now more ſeparated from the 2d.

0 45. 1¼ projection f. R.

1 22. 1 projection f. R.

Sept. 21. 21 15. 2½ projections preceding the edge.

22 44. Near 3 projections p. R. (S).

Sept. 23. 22 51. The 3d ſat. 1 projection f. the edge (T).

Sept. 24. 19 56. 1½ dia. of R. f. the edge; about 2 diameters of the 4th ſatellite farther from R. than the 4th, and a little more ſouth.

20 48. It advances towards a conjunction with the 4th.

	h.	′	″	°		h.	′	″	°
(P)	7	50	55.	256,9.	(Q)	10	20	34.	345,0.
(R)	11	17	33.	147,6.	(S)	10	30	44.	224,8.
(T)	10	29	52.	24,3.					

22 47.

22 47. It is paſt by the 4th. By a figure, it is about half its own diameter paſt the conjunction, and is more ſouth than the 4th (V).

Sept. 25. 19 34. (W).

Oct. 12. 20 37. The 3d ſat. about 3½ dia. of ♄ f. the body (X).

Oct. 15. 20 47. 1¼ dia. of ♄ p. the body.

21 30. A little more than 1 dia. of ♄ from the body; and its whole diameter north of the line of the projection.

22 25. The 3d ſat. will be in conjunction with the 6th, in a very ſhort time, the 3d being ſtill a little preceding.

22 39. The conjunction is ſo complete now, that I have loſt the 6th. The 3d, however, appears to be a little lengthened out towards the ſouth. Diſtance from the body barely one diameter of ♄; or juſt one dia. of ♄ including the dia. of the 3d (Y).

23 54. Near two of its own diameters paſt the conjunction with the 6th.

0 59. The 1ſt, the 3d, and the 6th, are at equal diſtances from each other.

1 14. The 3d is nearer to the 1ſt than to the 6th.

1 35. The 3d approaches to a conjunction with the 1ſt.

1 45. The 3d is very near its conjunction with the 1ſt. By a figure, it wants leſs than ½ a dia. of the 3d.

Oct. 16. 20 16. The 3d, 1¾ dia. of ♄ following the body.

21 59. It draws towards a conjunction with the 4th. The colour of the 3d is inclining to blue.

(V) 10 h. 21′ 57″. 103°,6.

(W) 7 h. 5′ 33″. 172°,5. Hence it appears that the ſatellite could not be ſeen this night.

(X) 7 h. 1′ 39″. 88°,2. (Y) 8 h. 51′ 33″. 333°,5.

0 9. The 3d is in conjunction with the 4th, or ¼ of the dia. of the 4th ſatellite paſt the conjunction; and one of its own dia. more north than the 4th; that is, there is a vacancy between them of one dia. of the 3d (Z).

Oct. 18. 20 18. 1 dia. of ♄ preceding the body.

21 51. 1¼ dia. of ♄ p. the body (A).

Oct. 20. 22 19. With 300, I ſee the 3d ſat. emerging; about ¾ of its own dia. is out, at the following ſide of ♄.

22 44. At the diſtance of ¾ of its dia. following the body (B).

0 8. The f. projection paſſes over the 3d ſat. juſt ſo as to clear it.

Oct. 28. 21 1. The 3d about 3 dia. of ♄ p. the body (C).

Oct. 30. 20 53. About 3 dia. of ♄ following the body (D).

Oct. 31. 21 13. ⅝ dia. of ♄ following the body.

21 57. There is a complete conjunction between the 3d ſat. and the 2d; the following arm of the ring paſſes exactly between them, and points to the 6th. The diſtance between the 3d and 2d is about ½ the diameter of the 3d ſatellite, the 2d being to the north, and the 3d to the ſouth (E).

22 0. I can ſee that the conjunction between the 3d and 2d ſatellites is paſt.

23 13. The 3d, ¼ dia. of ♄ following the body (F).

23 49. The 3d approaching to a contact with the body, but I can ſee a diviſion yet.

23 58. A diviſion ſtill viſible between the 3d ſatellite and the body of ♄.

	h.	′	″	°		h.	′	″	°
(Z)	10	17	22.	57,9.	(A)	7	51	54.	209,4.
(B)	8	36	54.	11,4.	(C)	6	22	47.	281,8.
(D)	6	6	57.	80,4.	(E)	7	6	51.	163,5.
(F)	8	22	39.	167,7.					

Nov. 2. 21 6. The 3d ſatellite, $1\frac{3}{4}$ dia. of ♄ p. the body; juſt following the 2d, but a little more north (G).

21 44. $1\frac{3}{4}$ dia. of ♄ preceding the body.

Nov. 3. 22 1. $2\frac{1}{4}$ dia. of ♄ f. the body (H).

Nov. 4. 22 17. About 2 dia. of ♄ following the body (I).

Nov. 7. From 21 h. 28′ to 23 h. 12′ (K).

Nov. 8. 20 46. At a conſiderable diſtance following (L).

Nov. 9. 1 2. $\frac{1}{8}$ dia. of ♄ following the body; its whole dia. is ſouth of the arm (M).

Nov. 10. 23 30. As the calculation gives it (N).

Nov. 13. 22 33. On the following ſide of ♄ (O).

Nov. 15. 22 33. At ſome diſtance, preceding (P).

Nov. 16. 22 50. (Q).

Nov. 21. 1 54. The 3d, about $1\frac{1}{2}$ dia. of ♄ f. the body (R).

Nov. 25. 1 21. (S).

Nov. 30. 23 47. The 3d ſat. about $2\frac{1}{2}$ of its own dia. following the 6th (T).

Dec. 2. 23 36. $\frac{3}{4}$ of the projection p. the body; its whole diameter is to the ſouth of the arm.

0 22. The 3d, the 1ſt, and the 6th, nearly at equal diſtances from each other.

	h.	′	″	°		h.	′	″	°
(G)	6	8	9.	319,6.	(H)	6	59	4.	42,5.
(I)	7	11	6.	122,5.					

(K) From 6 h. 10′ 28″ to 7 h. 54′ 11″. 358°,3 to 4°,0, and conſequently inviſible.

	h.	′	″	°		h.	′	″	°
(L)	5	24	39.	75,5.	(M)	9	36	1.	169,1.
(N)	8	0	21.	243,5.	(O)	6	51	44.	118,8.
(P)	6	43	53.	277,8.	(Q)	6	56	55.	358,2. inviſible.
(R)	8	40	57.	42,4.	(S)	8	52	10.	1,8. therefore inviſible.
(T)	6	58	48.	33,9.					

0 50. The 3d and 1ſt are in conjunction with a little ſpace between them; the 3d being to the ſouth, and the 1ſt to the north (V).

Dec. 5. 0 10. As the calculation gives it (W).

Dec. 16. 23 59. 1½ dia. of ♄ p. the body (X).

Obſervations on the ſecond ſatellite of Saturn.

July 18. 19 50. The 2d ſatellite in the line of the ring p. Saturn; but about 2 or 3° north (A).

July 23. 19 29. ¾ dia. of ♄ preceding (B).

July 27. 20 24. Upon the ff. part of the R. are two ſmall bright points, the largeſt is to the ſouth, and is neareſt to the body of ♄. (C).

20 29. The largeſt of the knobs is about ¼ dia. of ♄ from the body. Memorandum, I have no doubt, but that the large knob is the 2d ſatellite; I could nearly ſee its whole diameter to the ſouth of the ring, but not ſeparated. Clouds came on (D).

July 28. 19 40. The 2d ſat. of ♄ ¾ dia. following.

22 34. Almoſt a dia. f. (E).

	h.	′	″	°		h.	′	″	°
(V)	7	53	47.	196,3.	(W)	7	2	7.	72.4.
(X)	6	7	58.	225,5.	(A)	11	52	21.	271,6.
(B)	11	11	47.	205,8.					

(C) By calculation we find that theſe two bright points were the 2d and 6th ſatellites; but at the time of theſe obſervations I only took down phænomena as they preſented themſelves, leaving a ſolution of them to future conſiderations. See Note (B) to the 6th ſatellite.

(D) 11 h. 55′ 55″. 16°,0. (E) 13 h. 56′ 39″. 158°,7.

Aug. 18. 21 11. ¾ dia. f. R. (F).

Aug. 28. 0 14. Near 2 dia. of ♄ p. the body (G).

Aug. 29. 22 18. About 1 dia. of ♄ p. the body (H).

Aug. 31. 20 48. A few ſeconds nearear to ♄ than the 4th ſatellite, and a little more north (I)

Sept. 8. 22 30. The 2d ſat. 1¾ dia. of ♄ p. the body (K).

Sept. 10. 19 42. The 2d within 1 or 2 of its own diameters of the edge of the projection (L).

23 2. Inviſible.

Sept. 11. 20 26. The 2d, 1¾ dia. of ♄ preceding the body.

22 36. 1¼, or almoſt 1½ dia. of ♄ preceding the body.

1 34. 1¼ of the projection preceding R.

1 57. 1 projection p. R. (M)

Sept. 13. 22 6. There are two ſatellites emerging inſtead of one (N).

22 13. With 300, the neareſt, 1½ of its own diameters preceding the projection. This I take to be the 2d ſatellite (O).

Sept. 14. 20 27. Barely 1 projection p. R. and a little north.

21 55. The 2d, 1 dia. of the ſatellite p. R. (P).

22 23. The 2d, is now vaniſhed (Q). With 300, I think there is about ½ dia. of the ſatellite left.

22 30. There now, certainly, is nothing left of the 2d ſat.

Sept. 16. 19 39. The 2d ſat. 1¼ of the projection p. R. (R).

	h.	′	″	°		h.	′	″	°
(F)	11	11	27.	26,8.	(G)	13	34	42.	276,0.
(H)	11	35	5.	36,7.	(I)	9	57	29.	291,0.
(K)	11	7	48.	270,3.	(L)	8	12	24.	157,5.
(M)	14	22	27.	322,9.					

(N) See the obſervation of the 1ſt ſat. Sept. 13.

(O) 10 h. 31′ 13.″ 205°,0. (P) 10 h. 9′ 21″. 334°,6.

(Q) The word vaniſhed is here probably meant to denote its being gone upon the ring, to the projection of which it was approaching 28′ before.

(R) 7 h. 45′ 48″. 224°,9.

22 15. 1 dia. of ♄ from the edge of the R. preceding, and exactly in the line of the R.

23 59. Almoſt 1 dia. of the R. preceding the edge of it.

1 3. About 1¼ dia. of ♄ from the preceding edge.

Sept. 17. 19 48. (S).

Sept. 18. 21 15. The 2d ſat. 1¼ of the projection f. the edge; it is 1 dia. of the 1ſt ſatellite nearer to ♄ than the 1ſt, and a little more ſouth.

22 35. A little leſs than 1 projection f. the edge.

23 14. About ¾ of the projection f. the edge.

0 12. ¼ of the projection following, and a little ſouth.

0 27. With 300, the 2d ſat. 1 of its own dia. f. the R.

0 51. With 157, the 2d ſat. cloſe to the R. ſo that no diviſion can be perceived (T).

0 55. With 300, the ſatellite touches the R. and is a little ſouth; its whole dia. is ſtill out.

0 58. With 300, about ¾ of the dia. of the 2d ſat. may yet be ſeen.

Sept. 20. 23 27. The 2d within one of its diameters following the 3d, and a little north (V).

23 51. The 2d is now more ſeparated from the 3d.

0 45. 2 projections f. the edge of the ring.

1 22. 2½ projections f. R.

Sept. 21. 21 20. (W).

Sept. 23. 22 51. Almoſt 1 dia. of the R. f. the edge (X).

(S) 7 h. 50′ 55″. 356,8 inviſible. (T) 12 h. 49′ 10″. 155°,7.

(V) 11 h. 17′ 33″. 50°,6.

(W) 9 h. 6′ 58″. 170°,2 conſequently inviſible.

(X) 10 h. 29′ 52″. 81°,0.

Sept. 24. 19 49. The 2d, upon the point of the ring p; but I can ſee no vacancy.

19 56. With 300, the ſame appearance nearly; but the weather is too hazy, and the planet too low to bear it well.

20 45. The 2d ſat. begins now to project a little, and is a little ſouth of the ring (Y).

20 48. I can ſee a diviſion between the 2d ſat. and the R.

Sept. 25. 19 34 to 22 h. 38′ (Z).

Oct. 12. 20 37. The 2d ſat. one full dia. of ♄ following the body (A).

Oct. 15. 20 54. The 2d ſat. 1½ dia. of ♄ f. the body (B).

23 20. About 1½ dia. of ♄ following.

Oct. 16. 20 16. The 2d ſat. ¾ dia. of ♄, or a little leſs p. the body (C).

20 36. ¾ dia. of ♄ p. the body.

22 35. 1¼ dia. of ♄ p. the body.

0 11. 1½ dia. of ♄ p. the body.

Oct. 17. 21 30. The 2d ſat. 1 projection p. the body of ♄; very hazy weather (D).

(Y) 8 h. 20′ 17″. 200°,7.

(Z) From 7 h. 5′ 33″ to 10 h. 9′ 3″, the ſatellite is not mentioned in my obſervations; though by calculation it appears, that its ſituation was from 325°,6 to 342°,3; and that therefore it ought to have been ſeen. I conclude from this that ſome particular cauſe muſt have rendered it inviſible. Moſt probably it ſuffered an occultation from the 1ſt ſatellite, which was ſituated in ſuch a manner as nearly to cover it the whole evening; in this caſe, the obſervation of the 1ſt belongs alſo to the 2d, ſince their diameters would certainly run together ſo as, perhaps, if the occultation was not always central, to form only one ſatellite, of rather a larger diameter than either of them.

	h.	′	″	°		h.	′	″	°
(A)	7	1	39.	42,4.	(B)	7	6	50.	77,7.
(C)	6	25	1.	205,4.	(D)	7	34	53.	343,4.

Oct. 18. 20 18. The 2d ſat. near 2 dia. of ♄ f. the body.

21 51. 1¾ dia. of ♄ f. the body.

0 52. It approaches to a conjunction with the 1ſt.

1 25. The 2d ſat. very nearly in conjunction with the 1ſt.

1 38. The conjunction is complete (E). By a figure, the 2d is towards the north of the 1ſt; but they ſeem to be in contact.

Oct. 20. 21 17. The 2d ſat. is emerged ſome time ago, and is now 1¼ of its own diameters from the body of ♄. I perceived the ſatellite as a protuberance before 20 h. 50′ (F).

Oct. 28. 20 58. The preceding arm, on the north ſide, very near to the body, contains a conſiderable ſatellite.

21 5. The 2d ſat. is cloſe to the body, on the p. ſide, to the north of the ring (G).

Oct. 29. 21 49. The 2d about 1⅜ dia. of ♄ f. the body (H).

Oct. 30. 20 53. About 2 dia. of ♄ p. the body (I).

Oct. 31. 21 13. The 2d, ¼ dia. of ♄ following the body.

21 57. There is a complete conjunction between the 2d and 3d. The arm paſſes exactly between them, and points to the 6th. The diſtance between the 2d and 3d is about ½ the dia. of the 3d; the 2d ſatellite being to the north, and the 3d to the ſouth (K).

22 0. I can ſee that the conjunction between the 2d and 3d ſatellites is paſt.

23 13. The 2d ſat. is paſt the conjunction with the 6th.

Nov. 2. 21 6. The 2d ſat. juſt preceding the 3d, but a little more ſouth.

21 44. 2 dia. of ♄ p. the body, and a little more ſouth than the 3d ſatellite (L).

	h.	′	″	°		h.	′	″	°
(E)	11	38	17.	137,2.	(F)	7	10	8.	15,9.
(G)	6	26	46.	344,6.	(H)	7	6	44.	119,8.
(I)	6	6	57.	245,9.	(K)	7	6	51.	22,9.
(L)	6	46	3.	284,1.					

Nov. 3. 22 1. The 2d ſat. 2 dia. of ♄ following the body (M).

Nov. 4. 23 42. The 2d ſat. ¼ dia. of ♄ p. the body (N).

23 57. The dia. of the 2d ſatellite is intirely ſouth of the p. arm.

Nov. 7. 21 28. The 2d and 1ſt ſatellites, about 1 dia. of ♄, or a little farther, p. R.

21 53. The 2d ſat. 1⅛ dia. of ♄ p. the body (O).

Nov. 8. 20 46 to 23 h. 40′ (P).

Nov. 10. 23 30. As the calculation gives it (Q).

Nov. 13. 22 33. On the preceding ſide (R).

Nov. 15. 22 33. The 2d ſat. is upon the preceding arm of the ring about half-way; all its dia. is towards the ſouth (S).

22 49. The 2d is not quite to the end of the R. yet, but keeps advancing.

22 56. ¾ of the projection preceding the body, or ¼ wanting to being at the end of the ring.

Nov. 26. 22 27. The 2d is upon the p. arm; its whole dia. is towards the ſouth (T).

0 28. The 2d is emerged ſome time paſt (V).

Dec. 2. 22 50. The 2d ſat. about 1¾ dia. of ♄ preceding the body (W).

Dec. 5. 0 10. As the calculation gives it (X).

h. ′ ″ ° h. ′ ″

(M) 6 59 4. 56,9. (N) 8 35 52. 197,3.

(O) 6 35 24. 220,9.

(P) 5 24 39. 346,1. The firſt part of the evening was not very clear, and afterwards, by the calculation, the ſatellite was inviſible.

h. ′ ″ ° h. ′ ″ °

(Q) 8 0 21. 263,4. (R) 6 51 44. 291,8.

(S) 6 43 53. 194,2. (T) 5 54 43. 196,5.

(V) To emerge was here probably put for coming off the arm.

(W) 5 h. 54′ 6″. 265°,5. (X) 7 h. 2′ 7″. 306°,3.

Dec. 16. 23 59. The 2d, about 1¼ or 1⅜ dia. of ♄ p. the body (Y).

Obſervations on the firſt ſatellite of Saturn.

July 18. 19 50. The following part of the ring of Saturn, which is a very thin lucid line, ends in a bright point like a very faint ſatellite (A).

I ſuppoſe the bright point on the f. part of the ring to be a very ſmall fixed ſtar (B).

20 14. The bright point on the following part of R. ſeems to have its whole dia. towards the north; and in all appearance adheres to the line.

0 48. Poſſibly the bright point on the nf. part of the ring may be one of the ſatellites, and one of the before ſuppoſed ſatellites may be a ſmall fixed ſtar (C).

(Y) 6 h. 7′ 58″. 307°,8.

(A) 11 h 52′ 21″. 146,7. This ſhews, that the bright point was the 1ſt ſatellite.

(B) Being the firſt night of my viewing the ſatellites this year, their places were unknown. The 6th, which was in view, I took for the 1ſt ſatellite; but, the 2d, 3d, and 4th being alſo before me, there remained only the ſuppoſition of ſome ſmall fixed ſtar to account for the bright point.

(C) The motion of the bright point on the ring led me to the ſuppoſition of its being a ſatellite; and, to make room for one, it occurred, that one of the others might be a ſtar: for ſtill the thought of an unknown ſatellite did not happen to ſtrike me. I ſhould have made an attempt to calculate the places of the ſatellites by the manuſcript tables of M. DE LA LANDE, which are now printed in the *Connoiſſance des Temps* for 1791; but as there chanced to be an erratum of one day's motion in the epochæ of all the ſatellites for 1788, of which I was not aware, I had ſo little ſatisfaction from them the year before, that I laid them by as uſeleſs, and reſolved to inveſtigate the epochæ and revolutions of the ſatellites from my own obſervations.

21 15. The nf. bright point is advanced towards the body, ſo that it no longer hangs at the far end of the ring (D).

July 23. 19 29. (E).

July 27. 20 27. One dia. of ♄ f. is a ſmall ſatellite (F).

July 28. 19 40. The 1ſt ſat. 1½ dia. of ♄ preceding the body (G).

22 34. The 1ſt ſat. as before.

Aug. 18. 21 11. 1½ dia. of ♄ p. R. (H).

Aug. 28. 0 9. 1¼ or 1⅓ projection f. R. or 1 dia. of ♄ from the body (I).

Aug. 29. 22 18. About 1½ dia. of ♄ p. the body (K).

Aug. 31. 20 54. 1½ dia. of ♄ p. the body (L).

Sept. 8. 22 51. (M).

Sept. 10. 22 49 and 23 h. 4′ (N).

Sept.

(D) 13 h. 17′ 7″. 158°,0. Hence we ſee, that the ſatellite had advanced 11 degrees in its orbit towards ♄, ſince 11 h. 52′ 21″ which agrees with the motion of the bright point.

h. ′ ″
(E) 11 11 47. 15,1. Therefore the 1ſt ſatellite was not viſible.
(F) 11 53 55. 63,5. It was the firſt.
(G) 11 3 7. 247,5. The names of the ſatellites were by this time aſcertained, and I found that the above-mentioned manuſcript tables agreed pretty well with my obſervations this evening.

h. ′ ″ ° h. ′ ″ °
(H) 11 11 27. 294,3. (I) 13 49 42. 60,4.
(K) 11 35 5. 236,0. (L) 10 3 29. 245,4.
(M) 11 28 45. 342,9. Conſequently the ſatellite was inviſible, or at leaſt might eaſily be overlooked, ſo near the body upon the p. arm as it muſt have been ſituated; but there was an obſervation made upon what is called the 1ſt ſatellite, which will be reported hereafter. See obſervations on the 7th ſatellite, Sept. 8.

(N) From 11 h. 18′ 54″ to 11 h. 33′ 51″. 3°,1 to 5°,1. The 1ſt ſatellite was inviſible; but two obſervations were made upon what is called the firſt, which will be ſeen in the obſervations upon the 6th ſatellite. Such miſtakes may eaſily be

Sept. 11. 1 0. The 1ſt ſat. about 2 of its own dia. p. the projection; emerged ſince I looked laſt (O).

1 34. Half a projection p. R.

1 57. ¾ of the projection p. R.

Sept. 13. 22 0. There is a ſatellite emerging from the preceding arm; I take it to be the 1ſt (P).

22 6. There are two ſatellites emerging inſtead of one.

22 13. The one that emerged firſt, ⅓ of the projection p. R.

Sept. 14. 21 55. The 1ſt ſat. ¾ of the projection f. R. and a very little ſouth.

23 22. With 300, 1 or 1½ of its own dia. farther from the R. than the 6th, and a little more ſouth (Q).

0 42. 1½ projection f. R.

1 24. 1½ projection f. R.

1 46. Much the ſame as before.

Sept. 16. 19 39. The 1ſt ſat. ½ projection f. R (R).

22 18. 1½ projection f. the edge, and a very little ſouth.

23 59. About 1 dia. of ♄ f. the edge of the R.

1 3. ¾ dia. of ♄ f. R.

Sept. 17. 19 48. The 1ſt almoſt 1 projection p. R. (S).

20 38. 1⅓ projection p. R.

Sept. 18. 21 15. The 1ſt ſat. 1¾ projection f. R. or one of its own dia. following the 2d ſatellite (T).

22 35. 2 projections following the R.

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made during the time of obſervation, as a few hours will bring one of the inner ſatellites in view; but with ſuch accuracy of calculating the preciſe moment and ſituation of the ſatellites, as has now been uſed, there can be no doubt to which ſatellite an obſervation belongs.

	h.	′	″	°		h.	′	″	°
(O)	13	25	37.	210,7.	(P)	10	18	15.	207,4.
(Q)	11	36	6.	48,5.	(R)	7	45	52.	39,6.
(S)	7	50	55.	231,0.	(T)	9	13	45.	72,8.

0 14. 1¼ projection f. R.

Sept. 20. From 23 h. 24′ to 1 h. 28′ (V). Notwithſtanding my utmoſt endeavour, I could not perceive the 1ſt ſatellite. From the tables I ſurmiſe that it might be under an occultation, or eclipſed by the 3d ſatellite; I looked for it above two hours. It could be neither in the ſhadow of Saturn, nor in that of the ring.

Sept. 21. 21 15. The 1ſt ſat. 2 projections p. R. (W).

22 44. 1½ or 1¾ projection p. R.

Sept. 23. 22 51. ¾ projection p. R. and a very little north. It follows the 6th ſatellite 1 dia. of the 6th (X).

23 55. The 1ſt ſat. almoſt touches the ring; it may want one of its diameters. Clouds interrupted the obſervation.

Sept. 24. 19 49. The firſt ſat. 1¼ projection f. R. or about one of its own dia. f. the 6th.

20 45. The 1ſt ſat. 1 full projection f. R.

22 47. Cloſe to the following projection (Y).

Sept. 25. 19 34. The 1ſt ſat. 1 full projection p. the edge of R. and a little north.

20 41. A little more than ½ projection p. R.

22 38. The 1ſt ſat. has half its dia. projecting towards the north from the ring, on the preceding ſide; its place on the ring is about ⅔ of the projection from the body of ♄. The night is extremely clear (Z).

Oct. 12. 20 37. About ¼ dia. of ♄ p. the body.

21 24. ½ projection of R. preceding the edge, and conſiderably more north.

(V) From 11 h. 14′ 33″ to 13 h. 18′ 13″. 110°,4 to 126°,6.

	h.	′	″	°		h.	′	″	°
(W)	9	1	59.	283,5.	(X)	10	29	52.	316,7.
(Y)	10	21	57.	146,4.	(Z)	10	9	3.	335,5.

22 6. The 1ſt almoſt touches the p. projection.

22 24. It very nearly touches the p. projection.

23 26. ¾ of the projection p. the body of ♄; or, as it were, faſtened upon the projection, ¼ from the end of it (A).

1 8. I ſee nothing of the 1ſt ſat.

Oct. 15. 0 52. The 1ſt ſat. ½ projection from the body (B).

0 59. The diſtance of the 1ſt from the body is almoſt, but not quite, equal to the diſtance of the 1ſt, 3d, and 6th from each other.

1 14. The firſt is nearer to the 3d than the 3d to the 6th.

1 35. The 1ſt and 3d approach to a conjunction.

1 45. The 1ſt and 3d very near their conjunction.

Oct. 16. 0 11. The 1ſt ſatellite ¼ dia. of ♄ f. the body (C).

1 20. ¼ of the projection f. the edge of the R.; the weather remarkably clear. I can ſee the R. very diſtinctly, ſo as to judge with ſafety of the projection.

Oct. 18. 21 7. The 1ſt ſat. is lately emerged from the body of ♄ on the f. ſide.

21 12. The emerged ſat. 1 of its own dia. f. the body of ♄.

21 32. Above 2 of its own dia. following ♄.

21 51. The 1ſt ſat. ⅜ dia. of ♄ f. the body.

22 36. Very nearly clear of the f. projection (D). By hiding the planet behind the field-bar very carefully, I can ſee the projection of the R. very well on the f. ſide. The preceding projection cannot be diſtinguiſhed ſo well on account of the ſatellites (E) that are upon it.

0 52. The 1ſt ſat. approaches to a conjunction with the 2d.

1 25. The 1ſt and 2d ſat. very nearly in conjunction.

	h.	′	″	°		h.	′	″	°
(A)	9	50	11.	336,0.	(B)	11	4	11.	198,0.
(C)	10	19	22.	22,8.	(D)	8	36	47.	30,8.

(E) The 6th and 7th.

1 38. The conjunction is complete.

Oct. 20. 20 5. The 1ſt ſat. $\frac{1}{8}$ dia. of ♄ f. the body (F).

20 50. It draws towards a conjunction with the 6th ſat. diſtance 1 dia. of the 1ſt. The 1ſt is a little towards the north.

21 26. I can juſt ſee a very ſmall diviſion between the 1ſt and the 6th.

21 51. There is a perfect conjunction between the 1ſt and 6th.

Oct. 28. 21 1. The 1ſt ſat. 1 dia. of ♄ f. the body.

21 50. It draws towards a conjunction with the 6th, diſtance 1 full dia. of the 1ſt (G).

Oct. 29. 21 49. The 1ſt about $\frac{7}{8}$ dia. of ♄ p. the body (H).

Oct. 30. 20 53. The 1ſt ſat. $\frac{3}{4}$ dia. of ♄ f. the body (I).

Oct. 31. 21 13. $\frac{3}{4}$ dia. of ♄ p. the body (K).

23 13. $\frac{3}{8}$ dia. of ♄ p. the body; its whole dia. ſeems to be north of the arm.

Nov. 2. 23 26. I ſuppoſe the 1ſt ſat. to be upon the f. arm.

0 8. The f. arm contains a lucid point at the diſtance of $\frac{1}{8}$ dia. of ♄ f. the body.

0 34. The 1ſt ſat. almoſt $\frac{3}{4}$ dia. of ♄ f. the body (L).

Nov. 3. 22 3. The preceding arm is loaded in two places; at the far end, and about the middle.

23 48. The 1ſt ſat. $\frac{1}{2}$ dia. of ♄ p. the body (M); there ſeems to be another cloſely following it (N).

	h.	′	″	°		h.	′	″	°
(F)	5	58	20.	31,3.	(G)	7	11	39.	127,0.
(H)	7	6	44.	317,1.	(I)	6	6	57.	139,8.
(K)	6	22	59.	332,7.	(L)	9	35	35.	19,7.
(M)	8	45	47.	203,8.					

(N) It was the 6th.

0 10. I can diſtinguiſh the two ſatellites that follow one another upon the arm; the diſtance between them is ½ dia. of the ſmalleſt of them.

Nov. 4. 22 14. The 1ſt ſat. ¼ dia. of ♄ f. the body (O).

22 57. The dia. of the 1ſt ſat. is north of the arm.

Nov. 7. 21 28. The 1ſt and 2d about 1 dia. of ♄, or a little more, p. the body (P).

21 53. The 1ſt ſatellite 1¼ dia. of ♄ p. the body.

Nov. 8. 20 46. ⅞ dia. of ♄ f. the body (Q).

Nov. 10. 23 30. The 1ſt as the calculation gives it (R).

Nov. 13. 22 33. On the preceding ſide (S).

Nov. 15. 22 33. About ¾ dia. of ♄ p. the body (T).

Nov. 16. 22 50. Upon the end of the f. arm (V).

Nov. 21. 0 54. ¾ dia. of ♄ f. the body (W).

Dec. 2. 22 49. The 1ſt ſat. about 1 of its own dia. p. the 6th.

23 38. It is paſt the conjunction with the 6th, which it now follows, and it is a little more north than the 6th.

0 22. The 1ſt is equally diſtant from the following 6th, and the preceding 3d (X).

0 50. The 1ſt and 3d are in conjunction, with a little ſpace between them, the 1ſt being to the north.

Dec. 5. 0 8. (Y).

(O) 7 h. 8′ 6″. 21°,5.

(P) 6 h. 10′ 28″. 226°,0. By the equal diſtance which is mentioned, it appears, that the 1ſt and 2d ſatellites were in conjunction; and this agrees alſo with the next obſervation, compared with that of the 2d ſat. Nov. 7th.

	h.	′	″	°		h.	′	″	°
(Q)	5	24	39.	50,8.	(R)	8	0	21.	92,7.
(S)	6	51	44.	295,9.	(T)	6	43	53.	316,2.
(V)	6	56	55.	148,6.	(W)	8	40	57.	35,9.
(X)	7	25	51.	323,5.	(Y)	7	0	7.	172,1 inviſible.

Dec. 16. 23 59. The 1ſt ſat. a little more than 1 dia. of ♄ f. the body (Z).

Dec. 24. 0 5. (A).

Dec. 25. 1 36. The 1ſt ſat. is upon the end of the f. arm (B).

Obſervations on the ſixth ſatellite of Saturn.

July 18. 19 50. The *firſt ſatellite* of ♄ exactly in a line of the R. preceding (A).

July 27. 20 24. Upon the ff. part of the ring are two ſmall bright points; the largeſt, to the ſouth, is neareſt to the body (B), and the ſmalleſt, to the north, is at the farther end (C).

Aug. 28. 23 26. With the 40-feet reflector, I ſee the five known ſatellites of Saturn, and alſo another exactly in a line with the ring, interpoſed between the 2d ſatellite and the ring on the preceding ſide, while the 1ſt, 3d, 4th, and 5th are on the following one. It has ſo much the appearance of the other ſatellites, and ranges ſo well with them, that I have not a moment's doubt but that it is a ſixth ſatellite. It is leſs bright

(Z) 6 h. 7′ 58″. 102°,4.

(A) 5 h. 42′ 33″. 184°,3 inviſible.

(B) 7 h. 9′ 23″. 26°,3.

(A) By computation for 11 h. 52′ 21″ we find, that the 6th ſat. was 302,4; which is exactly in the place where a ſatellite called the firſt was obſerved; but it appears alſo from the calculation which has been given in the note A of the 1ſt ſatellite, that this obſervation cannot belong to the real 1ſt; the 6th ſatellite therefore was ſeen this evening without being known; and this explains all the difficulties which occurred with regard to the real 1ſt ſatellite. See obſervations on the 1ſt ſatellite, July 18.

(B) It was the 2d ſatellite. See obſervation on the 2d ſatellite, July 27.

(C) 11 h. 50′ 56″. 147°,1, which agrees exactly with the place of the 6th ſatellite.

than the reſt, but ſeems to have light enough to be ſeen by my 20-feet teleſcope.

0 9. 20-feet reflector. The new ſatellite $\frac{4}{5}$ of the projection of the ring preceding the edge of the R. (D).

0 20. A very ſmall ſtar about 60° ſf. ♄, and $1\frac{1}{4}$ dia. of ♄ diſtant from the body (E).

1 16. The ſmall ſtar is gradually left behind ſo as now to make an angle of about 35° ſf. ♄; while at the ſame time the planet has carried along with him the new ſatellite.

1 24. The 6th ſatellite $\frac{2}{3}$ of the projection of the R. p. the ring.

1 46. The ſame ſmall ſtar is now only about 25° ſf. ♄.

1 49. The new ſatellite is now not much more than $\frac{1}{2}$ the projection from the ring.

2 2. Saturn is gone on, in a retrograde order with reſpect to the ſmall ſtar, and has carried along with him the new diſcovered ſatellite.

Sept. 8. 22 30. The new or 6th ſat. $\frac{4}{5}$ of the projection of the R. directly preceding (F).

Sept. 10. 22 49. The *firſt ſatellite* leſs than the projection from the following arm; extremely faint (G).

23 4. The *firſt ſatellite* the length of the projection following the arm; it is ſo faint that I cannot expect to ſee the new ſatellite (H).

Sept.

(D) 13 h. 29′ 42″. 294°,2.

(E) This ſtar was immediately taken notice of, to verify the diſcovery of the 6th ſatellite.

(F) 11 h. 7′ 48″. 279°,2.

(G) 11 h. 18′ 54″. 86°,8. Which agrees perfectly with the 6th ſatellite, though it is here by miſtake called the 1ſt.

(H) As I miſtook the 6th ſatellite for the 1ſt, it was natural enough to find it very

Sept. 14. 21 59. I think I perceive a ſatellite between the 1ſt and the following projection cloſe to the ring. 300 leaves it doubtful (I).

22 23. The 6th ſat. ¾ of the projection f. R.; ſo cloſe to the 1ſt that it requires great attention to be diſtinguiſhed. With 300, the 6th is 1 or 1½ dia. of the 1ſt ſat. nearer the R. than the 1ſt, and a little more north than the 1ſt, that is to ſay, very exactly in the line of the ring.

23 45. With 460, the 6th ſat. is very near one whole projection f. R.

0 42. The 6th ſat. 1 full projection f. R. (K).

1 24. The new ſat. 1 projection f. R.

1 46. Very nearly, but not quite, 1 projection f. R.

Sept. 16. 22 18. The *third ſatellite* ½ the projection from the preceding edge of R.

22 25. The *third ſatellite* is extremely ſmall, and hardly to be ſeen; but I have no doubt.

23 59. *The third ſatellite* a little more than ½ the projection preceding the edge.

0 16. *The third* much leſs than the 1ſt and 2d, partly owing to its proximity to the planet; but probably there may be an apparent change of magnitude from a revolution upon its axis.

1 3. *The third* about ¾ of the projection p. R. (L).

Sept.

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very faint, and of courſe to ſuppoſe that the night was not clear enough to ſee the 6th, while at the ſame time I was making an obſervation on that very ſatellite. But it muſt here be remembered, that the time of its revolution was not yet well aſcertained.

(I) The calculation for 10 h. 13′ 20″ gives 46°.0, which ſhews that the ſatellite was there.

(K) 12 h. 55′ 53″. 75°,7.

(L) The 6th ſat. was this evening miſtaken for the 3d; but the calculation for 13 h.

Sept. 17. 19 52. The 6th ſat. 1 projection, or rather more f. the projection; extremely faint.

20 38. 1 full projection following (M).

22 55. ½ projection f. and a little ſouth; extremely ſmall.

23 49. ⅓ projection f. and a little ſouth.

0 58. ⅓ projection following.

1 46. Near ¾ of the projection following (N).

Sept. 21. 21 10. The 6th ſat. 1 full projection f. R.; much fainter than the 1ſt; hazy weather.

21 20. 1 full projection f. the edge, and exactly in the line of the ring. I ſee it very well; it is leſs than the 1ſt.

22 9. 1¼ of the projection f. the edge (O).

22 39. Nearly 1¼ projection f. the edge of the R. exactly in the line of the R.

Sept. 23. 22 51. The 6th ſat. 1 projection p. the edge; or 1 of its own diameters p. the 1ſt (P).

Sept. 24. 19 46. I ſuſpect the new or 6th ſatellite to be 1 projection f. the edge (Q).

19 49. The 6th is very near 1 projection f. the edge; it precedes the 1ſt ſat. about 1 dia. of the 1ſt.

20 45. The 6th a little more than ½ projection f. the edge.

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13 h. 8′ 59″, which gives 243°,7, ſhews that theſe obſervations belong to the 6th; and therefore explains all the difficulty about the ſuppoſed change of magnitude of the 3d.

(M) 8 h. 40′ 47″. 97°,6.

(N) The eſtimation ¾ is probably a miſtake in writing down, and ſhould have been ¼; perhaps alſo ſome change in the atmoſphere, or other circumſtance, may have induced an error of eſtimation, which, in ſuch minute objects, will now and then take place.

(O) 9 h. 55′ 50″. 82°,5. (P) 10 h. 29′ 52″. 254°,3.

(Q) 7 h. 21′ 28″. 122°,6.

Sept. 25. 22 36. The 6th almoſt ¾ projection f. the edge of the R.

23 42. The 6th ſat. very nearly 1 projection f. R. (R).

23 52. The 6th ſat. is much larger than the 7th.

Oct. 12. From 22 h. 6′ to 1 h. 8′ (S).

0 58. *The ſeventh ſat.* extremely ſmall upon the point of the preceding projection, and a little towards the ſouth.

1 20. The diſtance of *the ſeventh* increaſes. The ſatellite ſeems to be clear of the projection; but I can ſee no diviſion yet; its whole dia. ſeems to be to the ſouth; I ſee it full as well as I ſaw the 6th, or rather better (T).

1 35. *The ſeventh* is clear of the projection.

Oct. 15. 20 47. The 6th ſat. 1 dia. of ♄ p. the body.

21 34. The 6th about ¾ of the projection p. the edge of R. or very near 1 dia. of ♄ p. the body; juſt ſf. the 3d; it is in the line of the R. (V).

22 25. The 6th ſat. will be in conjunction with the 3d in a very ſhort time, the 3d being ſtill a little p.

22 39. The conjunction is ſo complete now, that I have loſt the 6th. The 3d, however, appears to be a little lengthened out towards the ſouth. Diſtance of the conjoined ſatellites

(R) 11 h. 12′ 52″. 67°,7.

(S) There were five obſervations made upon the 6th ſatellite, but they belong to the 7th. There were alſo three obſervations made upon the 7th which belong to the 6th, and are here given; we are to obſerve, that the revolution of the 7th was not yet aſcertained, and that, conſequently, a miſtake of one new ſatellite for another could eaſily be made.

(T) 11 h. 43′ 53″. 220°,9. The calculation of its place ſhews plainly that it was the 6th; and the remark in this obſervation of its being brighter than the other ſatellite perfectly agrees with the calculation.

(V) 7 h. 46′ 43″. 246°,0.

barely 1 dia. of ♄ from the body; or juſt 1 dia. of ♄, including the dia. of the 3d ſat.

23 59. The 6th near 2 diameters of the 3d ſatellite paſt the conjunction.

0 59. The 6th, the 3d, and the firſt ſatellites are at equal diſtances from each other.

1 3. The 6th is one dia. of ♄ from the body.

1 39. The 6th nearly 1 dia. of ♄ p. the body.

Oct. 16. 20 16. The 6th ſat. $\frac{2}{3}$ dia. of ♄ f. the body; too low to be very accurate.

20 36. The 6th one full projection f. the body; extremely faint.

20 50. The 6th one projection f. the body.

21 11. The 6th $\frac{3}{4}$ of a projection f. the body.

21 55. The 6th $\frac{1}{2}$ projection f. the body, or a little leſs (W).

22 5. The 6th advances towards a contact with the f. part of the body; I can, however, ſtill look between them.

22 18. I can ſtill ſee between the planet and the 6th ſat.

22 22. The 6th leſs than its own dia. from the planet.

22 25. It is in contact with the body of ♄.

22 41. I can ſtill perceive the 6th ſat.

22 44. The 6th is not quite vaniſhed.

22 47. The ſatellite is no longer viſible.

Oct. 17. 21 30. The 6th ſat. $\frac{1}{2}$ projection f. the body, very hazy weather (X).

Oct. 18. 20 40. The 6th ſat. is emerging from behind the 3d.

20 46. The 6th ſat. which emerged from behind the 3d is a little north of the line of the ring, and of the 3d.

(W) 8 h. 3′ 44″. 151°,9.

(X) 7 h. 34′ 53″. 49°,4.

21 36. The 6th is going towards ♄, and is about ¾ dia. of ♄ preceding the body.

22 51. ¾ dia. of ♄ p. the body.

22 26. The 6th about ⅝ dia. of ♄ p. the body.

22 40. The 6th ½ dia. of ♄ p. the body.

23 17. The 6th approaches to a conjunction with the 7th.

23 37. The conjunction of the 6th and 7th ſatellites is paſt. The ſatellites are, however, too near the planet to ſee exactly how they are placed.

0 12. The 6th a little more than 1 of its own dia. p. the body of ♄ (Y).

Oct. 20. 20 5. The 6th ſat. 1¼ dia. of ♄ f. the body (Z).

20 50. The 6th and 1ſt ſatellites are drawing towards a conjunction; diſtance between them 1 dia. of the 1ſt ſat.

21 26. I can juſt ſee a very ſmall diviſion between the 6th and the 1ſt.

21 51. There is a perfect conjunction between the 6th and the 1ſt.

22 22. The 6th ſat. appears again.

22 43. The 6th is in the middle, between the 1ſt and 2d ſatellites.

23 50. I perceive the 6th ſat. near the 3d towards the 2d; and on the ſouth of the line that joins the 3d and 2d; but nearer the 3d than the 2d.

Oct. 28. 20 58. The 6th ſat. about ½ projection f. the edge of the R.

21 5. The 6th about ¾ dia. of ♄ f. the body (A).

Oct. 29. 21 49. The 6th juſt f. the 1ſt (B).

	h.	′	″	°		h.	′	″	°
(Y)	10	12	31.	341,0.	(Z)	5	58	20.	100,0.
(A)	6	26	46.	47,5.					
(B)	7	6	44.	317,5.	For the place of the 1ſt, ſee the 1ſt ſat. Oct. 29.				

Oct. 30. 20 55. I ſuſpect the 6th on the edge of the p. arm; but moon-light is too ſtrong.

23 44. The 6th ſat. $\frac{3}{4}$ projection p. the edge of the R.

23 55. The 6th ſat. $\frac{7}{8}$ dia. of ♄ p. the body.

0 42. The 6th ſat. $1\frac{1}{8}$ dia. of ♄ p. the body (C).

Oct. 31. 21 13. The 6th ſat. $\frac{7}{8}$ dia. of ♄ p. the body.

21 57. The f. arm of the R. paſſes between the 3d and 2d ſatellites, and points to the ſixth.

23 57. The 6th full $\frac{1}{2}$ dia. of ♄ following the body (D).

Nov. 2. 21 44. The 6th ſat. $1\frac{1}{8}$ dia. of ♄ p. the body, and a little north; extremely faint (E).

22 17. The 6th ſat. 1 full dia. or $1\frac{1}{16}$ dia. of ♄ p. and a very little north.

22 53. The 6th ſeems to be ſtill $1\frac{1}{16}$ dia. of ♄, or rather more, p. the body, but the weather is hazy and foggy.

23 15. The 6th ſat. 1 dia. of ♄ p. the body.

23 27. The 6th ſat. $\frac{4}{5}$ of the projection p. the edge or very near 1 dia. of ♄ p. the body.

0 15. The 6th ſat. $\frac{7}{8}$ dia. of ♄ p. the body.

0 58. The 6th ſat. is ſtill clear of the p. arm.

1 16. The 6th ſat. $\frac{5}{8}$ dia. of ♄ p. the body; a very little p. the edge of the ring, and a little north.

Nov. 3. 22 3. The p. arm is loaded in two places, at the far end and about the middle (F.)

23 54. There ſeems to be a ſatellite cloſely following the 1ſt (G).

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	h.	′	″	°		h.	′	″	°
(C)	9	55	20.	250,9.	(D)	9	6	32.	144,9.
(E)	6	46	3.	284,7.					

(F) They were the 1ſt and 6th ſatellites. See 1ſt ſat. Nov. 3.

(G) 8 h. 51′ 46″. 210°,5.

0 10. The diſtance between the two ſatellites upon the arm is half the dia. of the ſmalleſt.

Nov. 4. 22 17. The 6th ſatellite $\frac{7}{8}$ dia. of ♄ f. the body (H).

23 48. The 6th about $\frac{3}{4}$ or $\frac{7}{8}$ dia. of ♄ following the body.

Nov. 7. 21 28. The 6th towards the end upon the f. arm (I).

22 39. The 6th is drawn a little nearer towards ♄.

Nov. 8. 20 46. The 6th about $\frac{1}{2}$ dia. of ♄ f. hazy weather, I do not ſee it well enough to eſtimate its diſtance very exactly.

21 16. The 6th ſat. $\frac{5}{8}$ dia. of ♄ f. the body.

22 2. The 6th ſat. $\frac{7}{8}$ dia. of ♄ f. the body.

23 40. The 6th ſat. 1$\frac{1}{8}$ dia. of ♄ f. the body (K).

Nov. 9. 21 42. The 6th ſat. $\frac{5}{8}$ dia. of ♄ p. the body, and a little north (L).

Nov. 10. 21 33. The p. arm, near the end, ſeems to contain a ſat. probably the 6th.

21 39. The 6th full $\frac{3}{8}$ dia. of ♄ p. the body; almoſt intirely to the ſouth of the arm (M).

22 28. The 6th is clear of the p. arm, and is about $\frac{5}{8}$ dia. of ♄ p. the body.

23 27. The 6th almoſt $\frac{7}{8}$ dia. of ♄ p. the body.

0 10. The 6th ſat. 1 full dia. of ♄ p. the body.

Nov. 13. 22 33. The 6th ſat. on the p. ſide (N).

Nov. 15. 22 33. The 6th ſat. about 1 dia. of ♄ f. the body (O).

Nov. 19. 21 55. The 6th ſat. $\frac{7}{8}$ dia. of ♄ f. the body (P).

	h.	′	″	°		h.	′	″	°
(H)	7	11	6.	94,8.	(I)	6	10	28.	151,9.
(K)	8	18	11.	78,0.	(L)	6	16	34.	318,7.
(M)	6	9	39.	220,1.	(N)	6	51	44.	296,0.
(O)	6	43	53.	100,0.	(P)	5	50	17.	61,1.

Nov. 21. 0 54. The 6th at a little diſt. p. the edge of the ring (Q); cloudy weather.

Nov. 25. 1 21. The 6th about ¾ dia. of ♄ following the body (R).

1 27. The 6th about ½ the projection preceding the edge of the projection.

Nov. 26. 22 22. The 6th near 1 dia. of ♄ f. the body (S).

0 30. Very nearly in conjunction with the 4th.

Nov. 30. 23 47. The 6th full 7/8 dia. of ♄ f. the body; about 2½ dia. of the 3d ſat. p. the 3d (T).

Dec. 2. 22 49. The 6th about ¾ dia. of ♄ p. the body; about 1 dia. of the 1ſt f. the 1ſt.

23 38. The 6th ſat. is paſt its conjunction with the 1ſt, which it now precedes.

0 22. The 6th, the 1ſt, and 3d ſatellites, are nearly at equal diſtances from each other.

0 52. The 6th ſat. nearly 1 dia. of ♄ p. the body (V).

Dec. 5. 0 8. The 6th ſat. ½ projection p. the arm (W).

Dec. 15. 0 35. The 6th about ¾ dia. of ♄ f. the body, and a little north (X).

Dec. 16. 23 59. The 6th full 5/8 dia. of ♄ p. the body (Y).

Dec. 24. 0 5. The 6th ſat. 1 1/8 dia. of ♄ p. the body; or 1¼ projection p. the edge of R. (Z).

	h.	'	''	°		h.	'	''	°
(Q)	8	40	57.	257,8.	(R)	8	52	10.	230,7.
(S)	5	49	44.	100,1.	(T)	6	58	48.	83,6.
(V)	7	55	46.	259,4.	(W)	7	0	7.	317,3.
(X)	6	47	48.	62,0.	(Y)	6	7	58.	317,3.
(Z)	5	42	33.	254,2.					

Obſervations on the ſeventh ſatellite of Saturn.

Sept. 8. 22 51. The *firſt ſatellite* ½ the dia. or a little leſs of the projection ſf. R. (A).

Sept. 14. 1 29. A ſuppoſed 7th ſat. exceſſively faint, ½ projection p. R. exactly in the line of the R. fainter than the laſt new one.

1 46. The ſuppoſed 7th half a projection p. the R. (B).

Sept. 17. 21 0. A ſecond new ſatellite exceſſively faint, ½ projection p. the edge of the R. (C).

22 55. The new, or 7th ſat. ¼ projection p. R. ſo exceſſively ſmall that, if I had not ſeen it before, it would have been impoſſible to perceive it now.

(A) Not being acquainted with more than ſix ſatellites, and having the 2d, 3d, 4th, 5th, and 6th in view, it was natural enough to call the remaining one, on which this obſervation is made, the 1ſt; but from the note M of the 1ſt ſat. it appears, that it could not be in the place where this was ſeen; and by calculating from the tables of the 7th ſat. we have its place for 11 h. 28′ 45″. 106°,0, which agrees exactly with the ſituation pointed out. From a figure, it appears, that the ſat. was extremely ſmall, and leſs than half its diameter ſouth of the line of the R.

(B) I was now on the look-out for very ſmall ſtars that were in any ſituation likely to be ſatellites of ♄, and always noticed them: for inſtance, "Sept. 11. "20 h. 42′. A ſuppoſed 7th ſat. exactly in the line of the R. or a very little "ſouth, exceſſively faint, only to be ſeen when I hide ♄ by the field bar. Sept. "14. 20 h. 40′. The 7th of Sept. 11. is left in its place." So here this ſuppoſed 7th is marked down, and Sept. 16. 20 h. 13′ I find it is ſaid, that "the "ſuppoſed 7th of the 14th is a ſmall fixed ſtar, left in the place where it was that "evening; but as the configuration of ſtars which pointed out this ſuppoſed 7th was very coarſe, and hardly ſufficient to determine the place, and as by calculation it appears, that the 7th ſatellite was in the ſituation where this obſervation places it, at 13 h. 59′ 43″, *viz.* 278°,2, it is probable enough, that I ſaw the real ſatellite this evening.

(C) 9 h. 2′ 43″. 265°,6.

23 1. After a more attentive obſervation and hiding the planet, I ſee the 7th ſat. is not leſs than ½ projection p. R.

23 31. Forty-feet reflector. I ſee ſix ſatellites at once, and being perfectly aſſured that the 2d is inviſible, it becomes evident that Saturn has ſeven ſatellites. This new ſat. is exceſſively ſmall.

Sept. 18. 22 4. The new ſat. near ½ projection p. R. and a little ſouth, but ſo faint that I hardly perceive it (D).

22 36. I cannot perceive the new ſatellite with the utmoſt attention (E). Indeed it was ſo faint before, that I almoſt entertained a doubt of its reality.

Sept. 25. 23 48. The 7th ſat. I believe is between the 6th and the R. or ⅓ projection f. the edge (F).

23 52. I ſee it very plainly; it is much ſmaller than the 6th; I have many times this evening before ſuſpected it, but the weather has been too hazy.

Oct. 12. 22 6. *The ſixth ſat.* (G) cloſe to the f. projection, and a little north.

22 13. I ſee *the ſixth ſat.* very well; but the projection is too faint to eſtimate the diſtance by it with any accuracy.

22 24. *The ſixth* being nearer to Saturn on the f. ſide than the 1ſt on the preceding, muſt be quite cloſe to the f. projection, or touching it.

(D) 10 h. 2′ 37″. 303°5.

(E) From the calculated place 10 h. 34′ 32″. 312°,0, we ſee, that the ſatellite was drawn upon the arm, and therefore might eaſily be overlooked, eſpecially as its revolution was unknown.

(F) 11 h. 18′ 48″. 117°,9.

(G) The ſatellite is here called the 6th, and we have ſeen before, in the note (S) of the 6th ſat. that the 6th was called the 7th; but the tables of theſe ſatellites leave no doubt to which of them the obſervations belong.

Oct. 12. 23 35. *The ſixth ſat.* 1 projection, or perhaps a little leſs, f. the body; I ſee it with great difficulty, but have no doubt (H).

1 8. I ſee nothing of *the ſixth* (I).

Oct. 16. 20 23. The 7th ſat. ½ projection f. the body; that is, the ſat. is upon the middle of the arm (K).

20 36. The 7th a little more than ¼ projection f. the body; extremely faint.

20 50. The 7th ſat. 1 of its own dia. f. the body of ♄.

21 11. The 7th is very nearly in contact with the body.

21 15. I can ſtill perceive the 7th ſat. by means of the field bar hiding the planet.

21 55. The 7th is gone.

1 29. I have a ſtrong ſuſpicion of a ſat. upon the p. projection not far from the end of it (L).

Oct. 18. 21 25. I am pretty ſure the ſat. is about 1 of its own dia. p. ♄ (M).

21 26. Very clear. I ſee the 7th ſat. very plainly.

21 35. About 2 of its own dia. from the body of ♄, and a little north of the R.

21 43. The 7th ſat. ¾ projection p. the body.

21 51. The 7th ſat. ¼ dia. of ♄ p. the body.

22 26. The 7th ſat. ¼ dia. of ♄ p. the body.

(H) The calculated place 9h. 59′ 10″. 111°,2, gives the ſatellite farther from the arm than the obſervation; but as this alſo mentions the ſat. was ſeen with difficulty, the interval might appear leſs than it would have done in a very clear view of the ſat.

(I) The leaſt change in the atmoſphere would make the ſat. inviſible; and by the tables it alſo was now very nearly going upon the ring.

	h.	′	″	°		h.	′	″	°
(K)	6	31	59.	144,4.	(L)	11	37	9.	225,3.
(M)	7	25	58.	202,7.					

22 40. The 7th ſeems ſtill to be where it was.

23 17. The 7th approaches to a conjunction with the 6th.

23 37. The conjunction of the 7th and 6th ſatellites is paſt. They are too near the planet to ſee exactly how they are placed.

o 20. The 7th ſat. $\frac{5}{8}$, or near $\frac{3}{4}$, dia. of ♄ p. the body.

o 24. The 7th is clear of the projection.

o 36. The 7th near $\frac{1}{2}$ projection p. the edge of the ring. I ſee the R. well enough to eſtimate by it.

o 59. The 7th ſat. $\frac{3}{4}$, or nearly $\frac{7}{8}$, dia. of ♄ p. the body.

1 21. The 7th ſat. $\frac{7}{8}$ dia. of ♄ p. the body (N).

Oct. 20. 21 26. I have a glimmering ſight of the 7th ſat.

21 56. The 7th is perfectly detached from the p. arm.

23 5. The ſat. $\frac{3}{4}$ of the dia. of ♄ p. the body, or thereabout.

23 37. The 7th extremely faint, near 1 dia. of ♄ p. the body; but the eſtimation of the diſtance is not very exactly to be had, as I am obliged to hide the planet when I ſee the ſat. There is a high wind, and the air being dry, the teleſcope does not act ſo well as it did 1$\frac{1}{2}$ hour ago.

o 8. The 7th ſat. $\frac{3}{4}$ dia. of ♄ p. the body; or $\frac{1}{3}$ (or nearly $\frac{1}{2}$) projection p. R. I ſee the ring very plainly (O).

o 20. The 7th ſat. about $\frac{3}{4}$ dia. of ♄ p. the body.

1 20. The 7th ſat. about $\frac{5}{8}$ dia. of ♄ p. the body.

Nov. 4. 22 23. The p. arm ſeems to be loaded about $\frac{3}{8}$ dia. of ♄ from the body (P).

Nov. 7. 22 0. The 7th ſat. $\frac{7}{8}$ dia. of ♄ p. the body, exceſſively ſmall; but I ſee it extremely well, and can keep it in view; it is juſt following the 1ſt and 2d ſat.

	h.	′	″	°			h.	′	″	°
(N)	11	21	20.	265,1.		(O)	10	0	40.	287,9.
(P)	7	17	5.	214,3.						

22 9. I ſee the 7th extremely well, notwithſtanding its ſmallneſs.

22 39. The 7th about $\frac{7}{8}$ dia. of ♄ p. the body (Q).

23 12. The 7th nearly the ſame as at 22 h. 39′, or perhaps a little nearer to ♄.

Nov. 8. 21 17. The 7th is clear of the p. arm; but I do not ſee it well enough yet to eſtimate how much.

22 0. The 7th ſat. $\frac{3}{4}$ dia. of ♄ p. the body (R).

23 31. The 7th is upon the p. arm I ſuppoſe, for the weather is now very clear, and I ſee it no longer. There is a ſmall protuberant point on the arm, which I take to be the ſatellite; but, as it has been cloudy, I have not been able to follow it ſo as to ſee it go on ſince 22 h. 2′.

23 40. I ſee the 7th upon the arm.

Nov. 10. 21 39. The p. arm is a little gouty, not quite $\frac{5}{8}$ dia. of ♄ preceding the body (S).

Nov. 15. 22 27. The 7th ſat. is clear of the f. projection (T).

22 39. The 7th ſat. between the 6th and the projection of the R. and a very little to the north.

22 44. The 7th conſiderably leſs than the 6th; I ſee it however very well, notwithſtanding the difficulty of its ſituation.

22 56. By a figure, at a conſiderable diſtance following.

Nov. 16. 22 50. The 7th leſs than 1 dia. of the 1ſt following the firſt, and a little north (V).

Nov. 29. 0 38. A ſmall luminous point on the f. arm (W).

	h.	′	″	°		h.	′	″	°
(Q)	7	21	16.	281,4.	(R)	6	38	27.	291,9.
(S)	6	9	39.	328,5.	(T)	6	37	54.	85,7.
(V)	6	56	55.	112,8.	(W)	7	53	35.	53,3.

Dec. 2. 23 38. I ſuſpect the 7th to be juſt detached from the f. arm (X).

0 24. I cannot ſee the 7th, though I tried often for it.

0 56. The 7th ſat. is not viſible.

From the obſervations on the ſeven ſatellites of Saturn that have been here delivered, and cloſely compared with their calculated places, it appears evidently that the revolutions of theſe ſatellites are ſo well aſcertained, that we may, without heſitation, determine that no phænomenon on the ring of Saturn, in the ſhape of lucid ſpot, protuberant point, or latent ſatellite, can be occaſioned by any of them, when, upon computation, we find that the place of the ſatellite differs from that where ſuch appearances were obſerved. In conſequence of this deduction, I found, that the obſervations, which will be given preſently, could not be explained by any of the known ſatellites; it remained, therefore, to be examined to what cauſe to aſcribe the appearance of ſuch lucid ſpots.

The firſt idea that occurred was that of another ſatellite, ſtill cloſer to the ring than the ſeventh; and if a revolution, ſlower than about 15 hours and a quarter, could have been found, which would have taken in the moſt material places in which bright ſpots were ſeen, I ſhould have continued of opinion that an eighth ſatellite, exterior to the ring, did exiſt, notwithſtanding more obſervations had been wanting to put the matter out of all doubt. But this being impracticable, I examined, in the next place, what would be the reſult if theſe ſuppoſed ſatellites, or protuberant points, were attached to the plane or edge of the ring.

(X) 6 h. 41′ 59″. 100°,0.

As obſervations, carefully made, ſhould always take the lead of theories, I ſhall not be concerned if ſuch lucid ſpots as I am now going to admit, ſhould ſeem to contradict what has been ſaid in my laſt Paper, concerning the idea of inequalities, or protuberant points. We may however remark, that a lucid, and apparently protuberant point, may exiſt without any great inequality in the ring. A vivid light, for inſtance, will ſeem to project greatly beyond the limits of the body upon which it is placed. If therefore the luminous places on the ring ſhould be ſuch as proceed from very bright reflecting regions, or, which is more probable, owe their exiſtence to the more fluctuating cauſes, of inherent fires acting with great violence, we need not imagine the ring of Saturn to be very uneven or diſtorted, in order to preſent us with ſuch appearances as will be related. In this ſenſe of the word, then, we may ſtill oppoſe the idea of protuberant points, ſuch as would denote immenſe mountains of elevated ſurface.

On comparing together ſeveral obſervations, a few trials ſhew that the brighteſt and beſt obſerved ſpot agrees to a revolution of 10 h. 32′ 15″,4; and, calculating its diſtance from the center of Saturn on a ſuppoſition of its being a ſatellite, we find it 17″,227, which brings it upon the ring. It is therefore certain, that unleſs we ſhould imagine the ring to be ſufficiently fluid to permit a ſatellite to revolve in it, or ſuppoſe a notch, groove, or diviſion in the ring, to ſuffer the ſatellite to paſs along, we ought to admit a revolution of the ring itſelf.

The denſity of the ring indeed may be ſuppoſed to be very inconſiderable by thoſe who imagine its light to be rather the effect of ſome ſhining fluid, like an aurora borealis, than a reflection from ſome permanent ſubſtance; but its diſapparition in general, and in my teleſcopes its faintneſs when turned edgeways,

ways, are in no manner favourable to this idea. When we add alſo, that this ring caſts a deep ſhadow upon the planet, is very ſharply defined both in its outer and inner edge, and in brightneſs exceeds the planet itſelf, it ſeems to be almoſt proved, that its conſiſtence cannot be leſs than that of the body of Saturn; and that conſequently, no degree of fluidity can be admitted ſufficient to permit a revolving body to keep in motion for any conſiderable time.

A groove might afford a paſſage, eſpecially as on a former occaſion we have already conſidered the idea of a divided ring. A circumſtance alſo which ſeems rather to favour this idea is, that, in ſome obſervations, a bright ſpot has been ſeen to project equally on both ſides, as the ſatellites have been obſerved to do when they paſſed behind the ring. But, on the other hand, we ought to conſider that the ſpot has often been obſerved very near the end of the arms of Saturn's ring, and that the calculated diſtance is conſequently a little too ſmall for ſuch appearances, and ought to be 19 or 20 ſeconds at leaſt. We ſhould alſo attend to the ſize of the ſpot, which ſeems to be variable; for it is hardly to be imagined that a ſatellite, brighter than the ſixth, and which could be ſeen with the moon nearly at the full, ſhould ſo often eſcape our notice in its frequent revolutions, unleſs it varied much in its apparent brightneſs.

To this we muſt add another argument drawn from the number of lucid ſpots, which will not agree with the motion of one ſatellite only; whereas, by admitting a revolution of the ring itſelf, in 10 h. 32′ 15″,4; and ſuppoſing all the ſpots to adhere to the ring, and to ſhare in the ſame periodical return, provided they laſt long enough to be ſeen many times, we ſhall be able to give an eaſy ſolution to all the remaining obſervations.

For inſtance, let α, β, γ, δ, ε, repreſent five ſpots on the ring of Saturn, ſituated as in fig. 2.; where the ring is ſuppoſed to be divided into 360 degrees, and the ſpot α placed at 271°,5; β at 70°,2; γ at 183°,0; δ at 142°,5; and ε at 358°,6. Then will the ring, with the ſpots thus placed, ſerve as an epocha for the year 1789; by which, with the aſſiſtance of a table conſtructed upon the before-mentioned period of the rotation of the ring, we may calculate their ſituation for any required time; and to render this calculation perfectly convenient, I have given a table, ready prepared for the purpoſe, at the end of the other tables.

The following obſervations have all been previouſly calculated by the tables of ſuch of the ſeven ſatellites as were not already in view, and have been found to belong to neither of them; but in the notes that are given with them they have been again calculated by the table of the rotation of the ring for every time they were obſerved, on a ſuppoſition of their being ſpots adhering to it.

Obſervations not accounted for by ſatellites.

July 28. 22 31. I now perceive between the neareſt ſat. and ♄, on the f. ſide, a ſmall lucid point, like an emerging ſatellite (A).

22 37.

(A) My ſurmiſe of its being an emerging ſatellite ſo early as the beginning of the ſeaſon, when I was ſtill unacquainted with the minute phænomena that offered themſelves afterwards, ſhews plainly, that the lucid point was of a ſufficient brightneſs to deſerve notice. The five old ſatellites were in view, and the 6th

22 37. The laſt diſcovered point, not quite half-way between the 3d ſat. and the body of Saturn; may be it is a 6th ſat. By a figure, the greateſt part of its diameter is to the north of the ring (B).

Aug. 29. 23 1. The preceding projection contains a ſmall inequality. By a figure, it follows the 3d ſat. about $\frac{1}{3}$ of the projection of the ring (C).

Sept. 16. 19 39. I ſuſpect one of the ſatellites cloſe to the ring following (D).

20 6. I am pretty ſure there is a ſatellite cloſe to the following arm, and a very little to the north. 300 leaves it doubtful (E).

Oct. 15. 20 58. I ſuſpect a ſatellite upon the preceding projection, not far from the end of it (F).

21 39. I cannot perceive the ſatellite on the preceding arm ſuſpected at 20 h. 58′ (G).

6th and 7th by calculation could not occaſion this appearance, the former being at 72°,3; the latter on the oppoſite ſide at 299°,4. Suppoſing this, therefore, to be the ſpot I have called α, its place for 13 h. 53′ 39″ would be 36°,8; which might make it appear like an emerging ſatellite.

(B) By this time the ſpot was at 40°,3, which agrees with the obſerved ſituation. As the greateſt part of its diameter appeared to be north, we may ſurmiſe, that the ſpot, which muſt have been of a very conſiderable ſize and brightneſs, was ſituated on the northern plane of the ring, and within a ſecond or two from the outward edge of it. The ring itſelf was now ſo near having its edge directed towards us, that it required no great elevation of the ſpot to render it viſible, notwithſtanding it was then in the fartheſt part of its circuit.

(C) The ſpot α, at 12 h. 17′ 58″ was 301°,5.

(D) The ſpot β, at 7 h. 45′ 52″ was 58°,1. This ſpot was probably alſo on the northern plane, and on the very edge, but not ſo conſiderable as α.

(E) It was now advanced to 73°,4.

(F) The ſpot γ, at 7 h. 10′ 49″ was 305°,0. Its ſituation on the ring was probably on the ſouthern plane, and at ſome conſiderable diſtance from the outward edge.

(G) It was now advanced to 328°,3; and therefore could hardly be ſeen any longer.

Oct. 16. 1 29. I was not without a ſuſpicion of another ſatellite upon the preceding arm, not quite ſo far advanced as the former (H).

Oct. 18. 20 22. I ſuſpect two ſatellites upon the p. arm (I).

20 42. I make no doubt but that there is at leaſt one ſat. upon the p. arm (K).

21 14. I am in doubt whether it be a ſat. upon the p. arm, or the arm itſelf (L).

21 17. Unleſs the p. arm be much brighter than the f. one, it muſt contain a ſatellite (M).

1 1. I am pretty ſure the end of the preceding projection is loaded with two ſatellites. By a figure, one is placed $\frac{1}{4}$ projection from the end; the other, $\frac{1}{3}$ projection from the body (N).

Oct. 18. 1 5. I can diſtinguiſh one upon the preceding projection very certainly (O).

Oct. 20. 21 26. I ſuſpect the end of the preceding arm to be loaded with a ſatellite (P)

(H) The ſpot β. By calculation, at 11 h. 37′ 9″ it was 309°,2, or juſt following the 7th ſatellite, which appeared then upon the preceding arm in the ſhape of a ſmall bright point.

(I) The ſpots γ and δ. The former at 6 h. 23′ 9″ was 217°,6, the latter 289°,9. δ is probably a ſpot upon the northern plane of the ring of a conſiderable degree of brightneſs, though but ſmall in its dimenſions, and at no great diſtance from the edge.

(K) The ſpot γ was by this time at 229°,0, and therefore in a ſituation to be eaſily perceived.

(L) The ſpot γ 247°,2. (M) The ſpot γ 248°,9.

(N) The ſpot α, at 11 h. 1′ 23″, was at 217°,2; and ε was alſo viſible, being at 304°,3. This ſpot is probably a very ſmall one, on the northern plane of the ring, at ſome diſtance from the edge.

(O) The ſpot α was now at 219°,4, and being very bright could be diſtinguiſhed eaſily. (P) The ſpot α, at 7 h. 19′ 7″, was at 290°,7.

21 56.

21 56. The preceding arm is certainly loaded with one or two ſatellites, or is more knotty than I have ever obſerved it to be. The weather is very beautiful (Q).

Oct. 30. 20 53. I ſuppoſe the 7th to be upon the following arm $\frac{1}{4}$ dia. of ♄ f. the body (R).

23 55. The 7th ſat. $\frac{3}{8}$ dia. of ♄ p. the body, or very near to the end of the p. arm, in the ſhape of a protuberant point (S).

0 1. I ſee it ſo well that there is no doubt but that it is a ſatellite (T).

0 42. The 7th is upon the p. arm, but a little nearer than it was before (V).

0 47. The 7th ſat. $\frac{3}{8}$ dia. of ♄ p. the body (W).

Oct. 31. 21 13. The 7th ſat. $\frac{3}{8}$ dia. of ♄ p. the body (X).

21 43. The 7th ſat. is brighter than uſual; I ſee it with great eaſe, notwithſtanding the moon is almoſt at the full. It is brighter now than the 6th (Y).

22 11. The 7th is drawn nearer to the body of ♄. Flying clouds prevent eſtimations of the diſtance (Z).

23 13. The 7th is now no longer viſible (A).

Nov. 2. 22 14. The 7th ſat. $\frac{3}{8}$ dia. of ♄ p. the body, it is upon the arm (B).

(Q) The ſpot α was now at 307°,8; and at the ſame time the ſpot β being come on as far as 219°,3, was therefore viſible.

(R) The ſpot δ, at 6 h. 6′ 57″ was at 40°,3.

(S) The ſpot α, at 9 h. 8′ 28″, was at 272°,4.

(T) It was now at 275°,8.

(V) At 299°,1. (W) At 302°,0.

(X) The ſpot α, at 6 h. 22′ 59″, was 278°,4.

(Y) It was now at 295°,5.

(Z) At 305°,7. (A) At 346°,7.

(B) The ſpot ε, at 7 h. 15′ 58″, was at 235°,6.

22 53. The 7th appears to be full ¼ dia. of ♄ p. the body; but hazy weather (C).

23 13. The 7th ſat. ¼ dia. of ♄ p. the body (D).

0 8. The following arm contains a lucid point near the end of it (E).

0 16. The preceding arm ſeems to be loaded with two ſmall points towards the end (F).

Nov. 4. 22 14. The 7th ſat. I think, is between the 1ſt and 6th, but I cannot be ſure (G).

22 27. I cannot perceive the 7th ſat. where I ſuſpected it (H).

23 47. The f. arm about ¼ dia. of ♄ from the body contains a ſmall lucid point (I).

23 54. I ſee the point on the f. arm ſo well that I have not much doubt but that it is a ſatellite (K).

Nov. 7. 22 9. At the end of the p. arm is a place that is brighter than nearer to the body (L).

23 12. The preceding arm has ſtill the appearance of a ſmall protuberant point towards the ſouth, near the end of the arm (M).

Nov. 8. 23 40. There is a protuberant point on the preceding arm beſides the 7th ſat.; ſo that at preſent I cannot tell whether the ſatellite be the neareſt or fartheſt of them (N).

(C) At 257°,8. (D) At 269°,1.

(E) The ſpot δ, at 84°,4. (F) The ſpot ε, at 305°,0.

(G) The ſpot ε, at 7 h. 8′ 7″, was at 71°,0, which agrees with the place, and it might be the ſuppoſed ſatellite. (H) At 78°,3.

(I) The ſpot α, at 8 h. 40′ 51″, was at 36°,7.

(K) It was now at 40°,7.

(L) The ſpot α, at 6 h. 51′ 21″, was at 274°,0.

(M) It was at 309°,8.

(N) The ſpot δ, at 8 h. 18′ 11″, was at 294°,4.

Nov. 10. 21 35. The following arm ¼ dia. of ♄ from the body contains a bright point; perhaps an 8th ſatellite (O).

Nov. 25. 1 21. The p. arm is loaded (P).

Nov. 29. 0 38. There are two ſmall luminous points on the p. arm (Q).

Dec. 5. 0 8. Upon the end of the p. arm appears to be a bright point (R).

0 10. The ſpot on the preceding arm is rather larger than the 6th ſatellite (S).

Dec. 16. 0 7. The end of the p. arm ſeems to be loaded with a ſatellite (T).

Dec. 24. 0 7. The p. arm contains a pretty bright point ⅔ towards the end of it (V).

Dec. 25. 23 39. The p. arm very near the end is loaded with a ſat. (W).

1 10. The p. arm is loaded very nearly at the far end of it, and a little towards the ſouth (X).

1 37. The bright point is near the far end of the p. arm (Y).

The great accordance between the obſerved places of theſe ſpots and the calculated ones, ſeems to eſtabliſh the rotation of the ring of Saturn on an axis ſo as hardly to leave any doubt upon the ſubject. The time of it, we have already ſeen, is 10 hours, 32 minutes, and 15,4 ſeconds. It may be objected,

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(O) The ſpot δ, at 6 h. 5′ 40″, was at 59°,1.

(P) The ſpot ε, at 8 h. 52′ 10″, was at 68°,6.

(Q) The ſpot β, at 7 h. 53′ 35″, was at 259°,6.

(R) The ſpot ε, at 7 h. 0′ 7″, was at 283°,8.

(S). It was now at 285°,0.

(T) The ſpot ε, at 6 h. 15′ 57″, was at 277°,4.

(V) The ſpot α, at 5 h. 44′ 33″, was at 251°,6.

(W) The ſpot β, at 5 h. 12′ 42″, was at 244°,8.

(X) It was now at 296°,0. (Y) And now at 311°,4.

that many of the obſervations are ſuch as would alſo agree with other aſſignable periods, eſpecially when the numbers of ſpots is ſo conſiderable as five; but the moſt material obſervations, which are thoſe on the ſpot α, ſetting aſide all the reſt, ſeem alone to amount to a proof not only of a rotation of the ring, but of the time in which it is performed.

It may be expected, that having now ſufficiently examined the whole ſeries of obſervations of the laſt new ſatellites, we can give their periodical times and diſtances more accurately than before. The times, indeed, are full as well aſcertained as we can expect to have them: for on calculating ſix ſatellites by my tables back to Aug. 19 d. 12 h. 19′ 56″, 1787, we find their places 341°,1 the 5th; 10°,6 the 4th; 211°,1 the 3d; 158°,9 the 2d; 80°,2 the 1ſt; and 288°,8 the 6th. And my journal contains the fulleſt aſſurance that they were thus ſituated at the time for which this calculation is made. We may therefore fix the period of the ſixth at 1 d. 8 h. 53′ 8″,9. The 7th ſatellite can only be traced back as far as the 8th of Sept. 1789; ſo that its revolution will require at leaſt another ſeaſon to come to ſome degree of accuracy, till when we ſhall ſtate it at 22 h. 37′ 22″,9.

The diſtance of theſe ſatellites, deduced from calculation, depends intirely upon the time and diſtance of the 4th, which is the ſatellite that has been uſed. In order to obtain more accuracy in theſe elements, I have applied myſelf to meaſuring the diſtance of the 4th ſatellite in thoſe moments which were moſt favourable for the purpoſe. It is well known that this ſubject, on account of the quantity of matter in Saturn, to be deduced from the periodical times and diſtances of the ſatellites, is of conſiderable importance to aſtronomers; I ſhall therefore defer a full inveſtigation of it till I can have an opportunity of calculating a great number of meaſures, not only of the 4th and 5th, but alſo of the other ſatellites which I have already by me, and ſtill intend next ſeaſon to take. Mean while, having brought the meaſures of the 30th of November, which ſeem to me to be very good ones, to the mean diſtance of Saturn from the ſun, I find they give the diſtance of the 4th ſatellite from Saturn 3′ 8″,918. In reducing theſe meaſures to the mean diſtance, I have uſed the new tables of M. de Lambre for Saturn, and Mayer's for the ſun.

Admitting therefore the above quantity as the diſtance, and 15 d. 22 h. 41′ 13″,4 as the period of the 4th ſatellite, we compute that the diſtance of the 6th from the center of Saturn is 36″,7889; and that of the 7th, 28″,6689.

Tables for the ſeven ſatellites of Saturn.

Epochs of the mean longitude of the ſatellites.

	5. ſat.	4. ſat.	3. ſat.	2. ſat.	1. ſat.	6. ſat.	7. ſat.
Years.	Deg.dec	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.
1787	335,91	149,16	87,21	272,18	176,46	269,31	307,07
1788	196,84	132,41	93,86	173,95	131,91	307,48	65,02
1789	53,23	93,09	20,82	304,19	256,66	82,92	161,00
1790	269,63	53,77	307,78	74,43	21,41	218,36	256,98
1791	126,02	14,45	234,74	204,68	146,16	353,81	352,97

Saturnicentric

Saturnicentric motion of the ſatellites in months.

	5th.	4th.	3d.	2d.	1ſt.	6th.	7th.
Months	Deg.dec	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.
January	000,00	000,00	000,00	000,00	000,00	000,00	000,00
Februa.	140,68	339,89	310,40	117,58	151,64	224,54	320,81
March	267,75	252,05	21,73	200,56	91,18	20.91	215,73
April	48,43	231,95	332,13	318,14	242,81	245,45	176,54
May	184,57	189,26	202,84	304,19	203,75	207,27	115,39
June	325,25	169,16	153,24	61,77	355,39	71,81	76,20
July	101,39	126,47	23,94	47,82	316,33	33,63	15,05
Auguſt	242,07	106,37	334,34	165,40	107,96	258,17	335,86
Septem.	22,75	86,26	284,74	282,98	259,60	122,72	296,67
October	158,89	43.58	155,45	269,03	220,54	84,54	235,52
Novem.	299,57	23,47	105,85	26,61	12,17	309,08	196,33
Decem.	75,71	340,78	336,56	12,66	333,11	270,90	135,17

In the months January and February of a biſſextile year ſubtract 1 from the number of days given.

Motion of the ſatellites in days.

	5th.	4th.	3d.	2d.	1ſt.	6th.	7th.
Days	Deg. Dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.
1	4,54	22,58	79,69	131,53	190,70	262,73	21,96
2	9,08	45,15	159,38	263,07	21,40	165,45	43,92
3	13,61	67,73	239,07	34,60	212,09	68,18	65,88
4	18,15	90,31	318,76	166,14	42,79	330,91	87,85
5	22,69	112,89	38,45	297,67	233,49	233,64	109,81
6	27,23	135,46	118,14	69,21	64,19	136,36	131,77
7	31,77	158,04	197,83	200,74	254,89	39,09	153,73
8	36,30	180,62	277,52	332,28	85,58	301,82	175,69
9	40,84	203,19	357,21	103,81	276,28	204,55	197,65
10	45,38	225,77	76,90	235,35	106,98	107,27	219,62
11	49,92	248,35	156,59	6,88	297,68	10,00	241,58
12	54,46	270,93	236,28	138,42	128,38	272,73	263,54
13	58,99	293,50	315,97	269,95	319,07	175,45	285,50
14	63,53	316,08	35,66	41,49	149,77	78,18	307,46
15	68,07	338,66	115,35	173,02	340,47	340,91	329,42
16	72,61	1,24	195,04	304,56	171,17	243,64	351,39
17	77,15	23,81	274,74	76,09	1,87	146,36	13,35
18	81,69	46,39	354,43	207,63	192,56	49,09	35,31
19	86,22	68,97	74,12	339,16	23,26	311,82	57,27
20	90,76	91,54	153,81	110,70	213,96	214,54	79,23
21	95,30	114,12	233,50	242,23	44,66	117,27	101,19
22	99,84	136,70	313,19	13,77	235,35	20,00	123,16
23	104,38	159,28	32,88	145,30	66,05	282,73	145,12
24	108,91	181,85	112,57	276,84	256,75	185,45	167,08
25	113,45	204,43	192,26	48,37	87,45	88,18	189,04
26	117,99	227,01	271,95	179,91	278,15	350,91	211,00
27	122,53	249,58	351,64	311,44	108,84	253,64	232,96
28	127,07	272,16	71,33	82,98	299,54	156,36	254,92
29	131,60	294,74	151,02	214,51	130,24	59,09	276,89
30	136,14	317,32	230,71	346,05	320,94	321,82	298,85
31	140,68	339,89	310,40	117,58	151,64	224,54	320,81

Motion of the ſatellites in hours.

	5th.	4th.	3d.	2d.	1ſt.	6th.	7th.
Hours.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.
1	0,19	0,94	3,32	5,48	7,95	10,95	15,92
2	0,38	1,88	6,64	10,96	15,89	21,89	31,83
3	0,57	2,82	9,96	16,44	23,84	32,84	47,75
4	0,76	3,76	13,28	21,92	31,78	43,79	63,66
5	0,95	4,70	16,60	27,40	39,73	54,73	79,58
6	1,13	5,64	19,92	32,88	47,67	65,68	95,49
7	1,32	6,58	23,24	38,36	55,62	76,63	111,41
8	1,51	7,53	26,56	43,84	63,57	87,58	127,32
9	1,70	8,47	29,88	49,33	71,51	98,52	143,24
10	1,89	9,41	33,20	54,81	79,46	109,47	159,15
11	2,08	10,35	36,52	60,29	87,40	120,42	175,07
12	2,27	11,29	39,84	65,77	95,35	131,36	190,98
13	2,46	12,23	43,17	71,25	103,29	142,31	206,90
14	2,65	13,17	46,49	76,73	111,24	153,26	222,81
15	2,84	14,11	49,81	82,21	119,19	164,20	238,73
16	3,03	15,05	53,13	87,69	127,13	175,15	254,64
17	3,21	15,99	56,45	93,17	135,08	186,10	270,56
18	3,40	16,93	59,77	98,65	143,02	197,05	286,47
19	3,59	17,87	63,09	104,13	150,97	207,99	302,39
20	3,78	18,81	66,41	109,61	158,91	218,94	318,30
21	3,97	19,75	69,73	115,09	166,86	229,89	334,22
22	4,16	20,70	73,05	120,57	174,81	240,83	350,13
23	4,35	21,64	76,37	126,05	182,75	251,78	6,05
24	4,54	22,58	79,69	131,53	190,70	262,73	21,96

Motion of the ſatellites in minutes.							
	5th.	4th.	3d.	2d.	1ſt.	6th.	7th.
Min.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.
1	0,00	0,02	0,06	0,09	0,13	0,18	0,27
2	0,01	0,03	0,11	0,18	0,26	0,36	0,53
3	0,01	0,05	0,17	0,27	0,40	0,55	0,80
4	0,01	0,06	0,22	0,37	0,53	0,73	1,06
5	0,02	0,08	0,28	0,46	0,66	0,91	1,33
6	0,02	0,09	0,33	0,55	0,79	1,09	1,59
7	0,02	0,11	0,39	0,64	0,93	1,28	1,86
8	0,03	0,13	0,44	0,73	1,06	1,46	2,12
9	0,03	0,14	0,50	0,82	1,19	1,64	2,39
10	0,03	0,16	0,55	0,91	1,32	1,82	2,65
11	0,04	0,17	0,61	1,00	1,46	2,01	2,92
12	0,04	0,19	0,66	1,10	1,59	2,19	3,18
13	0,04	0,20	0,72	1,19	1,72	2,37	3,45
14	0,05	0,22	0,77	1,28	1,85	2,55	3,71
15	0,05	0,24	0,83	1,37	1,99	2,74	3,98
16	0,05	0,25	0,89	1,46	2,12	2,92	4,24
17	0,06	0,27	0,94	1,55	2,25	3,10	4,51
18	0,06	0,28	1,00	1,64	2,38	3,28	4,78
19	0,06	0,30	1,05	1,73	2,52	3,47	5,04
20	0,07	0,31	1,11	1,83	2,65	3,65	5,31
21	0,07	0,33	1,16	1,92	2,78	3,83	5,57
22	0,07	0,34	1,22	2,01	2,91	4,01	5,84
23	0,08	0,36	1,27	2,10	3,05	4,20	6,10
24	0,08	0,38	1,33	2,19	3,18	4,38	6,37
25	0,08	0,39	1,38	2,28	3,31	4,56	6,63
26	0,09	0,41	1,44	2,37	3,44	4,74	6,90
27	0,09	0,42	1,49	2,47	3,57	4,93	7,16
28	0,09	0,44	1,55	2,56	3,71	5,11	7,43
29	0,10	0,45	1,60	2,65	3,84	5,29	7,69
30	0,10	0,47	1,66	2,74	3,97	5,47	7,96

Motion of the ſatellites in minutes.

	5th	4th.	3d	2d.	1ſt.	6th.	7th.
Min.	Deg. Dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.	Deg. dec.
31	0,10	0,49	1,72	2,83	4,10	5,66	8,22
32	0,11	0,50	1,77	2,92	4,24	5,84	8,49
33	0,11	0,52	1,83	3,01	4,37	6,02	8,75
34	0,11	0,53	1,88	3,10	4,50	6,20	9,02
35	0,12	0,55	1,94	3,20	4,63	6,39	9,29
36	0,12	0,56	1,99	3,29	4,77	6,57	9,55
37	0,12	0,58	2,05	3,38	4,90	6,75	9,82
38	0,13	0,60	2,10	3,47	5,03	6,93	10,08
39	0,13	0,61	2,16	3,56	5,16	7,12	10,35
40	0,13	0,63	2,21	3,65	5,30	7,30	10,61
41	0,14	0,64	2,27	3,74	5,43	7,48	10,88
42	0,14	0,66	2,32	3,83	5,56	7,66	11,14
43	0,14	0,67	2,38	3,93	5,69	7,85	11,41
44	0,15	0,69	2,43	4,02	5,83	8,03	11,67
45	0,15	0,71	2,49	4,11	5,96	8,21	11,94
46	0,15	0,72	2,55	4,20	6,09	8,39	12,20
47	0,16	0,74	2,60	4,29	6,22	8,58	12,47
48	0,16	0,75	2,66	4,38	6,36	8,76	12,73
49	0,16	0,77	2,71	4,47	6,49	8,94	13,00
50	0,17	0,78	2,77	4,57	6,62	9,12	13,27
51	0,17	0,80	2,82	4,66	6,75	9,30	13,53
52	0,17	0,82	2,88	4,75	6,88	9,49	13,80
53	0,17	0,83	2,93	4,84	7,02	9,67	14,06
54	0,18	0,85	2,99	4,93	7,15	9,85	14,33
55	0,18	0,86	3,04	5,02	7,28	10,03	14,59
56	0,18	0,88	3,10	5,11	7,41	10,22	14,86
57	0,19	0,89	3,15	5,20	7,55	10,40	15,12
58	0,19	0,91	3,21	5,30	7,68	10,58	15,39
59	0,19	0,93	3,27	5,39	7,81	10,76	15,65
60	0,20	0,94	3,32	5,48	7,94	10,95	15,92

Table of the rotation of the ring of Saturn.

Epochs for 1789.	
Spot α	271,5
β	183,0
γ	70,2
δ	142,5
ε	358,6

Motion of the ſpots in Months.

Months.	Deg. dec.
January	000,00
February	217,52
March	135,28
April	352,80
May	110,40
June	327,92
July	85,52
Auguſt	303,04
September	160,56
October	278,16
November	135,68
December	253,28

Motion of the ſpots in days, hours, and minutes.							
Days	Deg.dec	Hou.	Deg.dec	Min.	Deg.dec	Min.	Deg.dec
1	99,92	1	34,16	1	0,57	31	17,65
2	199,84	2	68,33	2	1,14	32	18,22
3	299,76	3	102,49	3	1,71	33	18,79
4	39,68	4	136,65	4	2,28	34	19,36
5	139,60	5	170,81	5	2,85	35	19,93
6	239,52	6	204,98	6	3,42	36	20,50
7	339,44	7	239,14	7	3,99	37	21,07
8	79,36	8	273,30	8	4,56	38	21,64
9	179,28	9	307,46	9	5,12	39	22,21
10	279,20	10	341,63	10	5,69	40	22,78
11	19,12	11	15,79	11	6,26	41	23,35
12	119,04	12	49,95	12	6,83	42	23,91
13	218,96	13	84,11	13	7,40	43	24,48
14	318,88	14	118,28	14	7,97	44	25,05
15	58,80	15	152,44	15	8,54	45	25,62
16	158,72	16	186,60	16	9,11	46	26,19
17	258,64	17	220,76	17	9,68	47	26,76
18	358,56	18	254,93	18	10,25	48	27,33
19	98,48	19	289,09	19	10,82	49	27,90
20	198,40	20	323,25	20	11,39	50	28,47
21	298,32	21	357,41	21	11,96	51	29,04
22	38,24	22	31,59	22	12,53	52	29,61
23	138,16	23	65,75	23	13,10	53	30,18
24	238,08	24	99,91	24	13,67	54	30,75
25	338,00			25	14,24	55	31,32
26	77,92			26	14,80	56	31,89
27	177,84			27	15,37	57	32,46
28	277,76			28	15,94	58	33,03
29	17,68			29	16,51	59	33,59
30	117,60			30	17,08	60	34,16
31	217,52						

Example of the uſe of the tables.

Let it be required to calculate the apparent place of the ſeven ſatellites for 1789. Oct. 18. 7 h. 51′ 54″, to the neareſt minute of time and to tenths of a degree.

	5th.	4th.	3d.	2d.	1ſt.	6th.	7th.
1789	53,23	93,09	20,82	304,19	256,66	82,92	161,00
Oct.	158,89	43,58	155,45	269,03	220,54	84,54	235,52
18	81,69	46,39	354,43	207,63	192,56	49,09	35,31
7	1,32	6,58	23,24	38,36	55,62	76,63	111,41
52	0,17	0,82	2,88	4,75	6,88	9,49	13,80
* ♄	12,58	12,58	12,58	12,58	12,58	12,58	12,58
	307,9	203,0	209,4	116,5	24,8	315,3	209,6

The ſituation of the ſpot α calculated for July 28. 13 h. 53′ 39″; β for Sept. 16. 7 h. 45′ 48″; ε for Nov. 2. 7 h. 15′ 58″.

1789, α	271,5	β	183,0	ε	358,6
July	85,52	Sept.	160,56	Nov.	135,68
28	277,76	16	158,72	2	199,84
13	84,11	7	239,14	7	239,14
54	30,75	46	26,19	16	9,11
♄	7,20	♄	10,45	♄	13,18
	36,8		58,1		235,6

* The quantity marked ♄ 12°,58, which is applied to every one of the ſatellites, is the complement of 11^{s} 17° 25′, or geocentric place of Saturn, taken from the Nautical Almanac, for midnight of the required day, and to the neareſt minute, which is ſufficiently exact. This complement, or 12° 35′ in conformity with the tables, is reduced to decimals of a degree 12°,58.

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